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# ROCKET INSTRUMENTATION DATA ASTROBEE 1500 FLIGHT 16.06 GR

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MARCH 1970



**GODDARD SPACE FLIGHT CENTER**  
GREENBELT, MARYLAND

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William B. McAlister  
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Sounding Rocket Instrumentation Section

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#### SUMMARY

This document contains a compilation of instrumentation information, including plotted data and curves, for the Astrobee 1500 rocket, Flight 16.06 GR. Included, is a compilation of data from calibration checks on various components, at the factory; and component and system tests, both at Goddard Space Flight Center and at the rocket launch site.

The purpose of the report is to present the rocket instrumentation test-data tolerances and accuracies, furnish a record of the instrumentation systems and their orientations, and to supply the necessary calibration data to be used in the reduction of post-flight data. It also serves as a permanent record of the flight, to be used by the rocket project managers in the planning of future Astrobee 1500 rocket flights.



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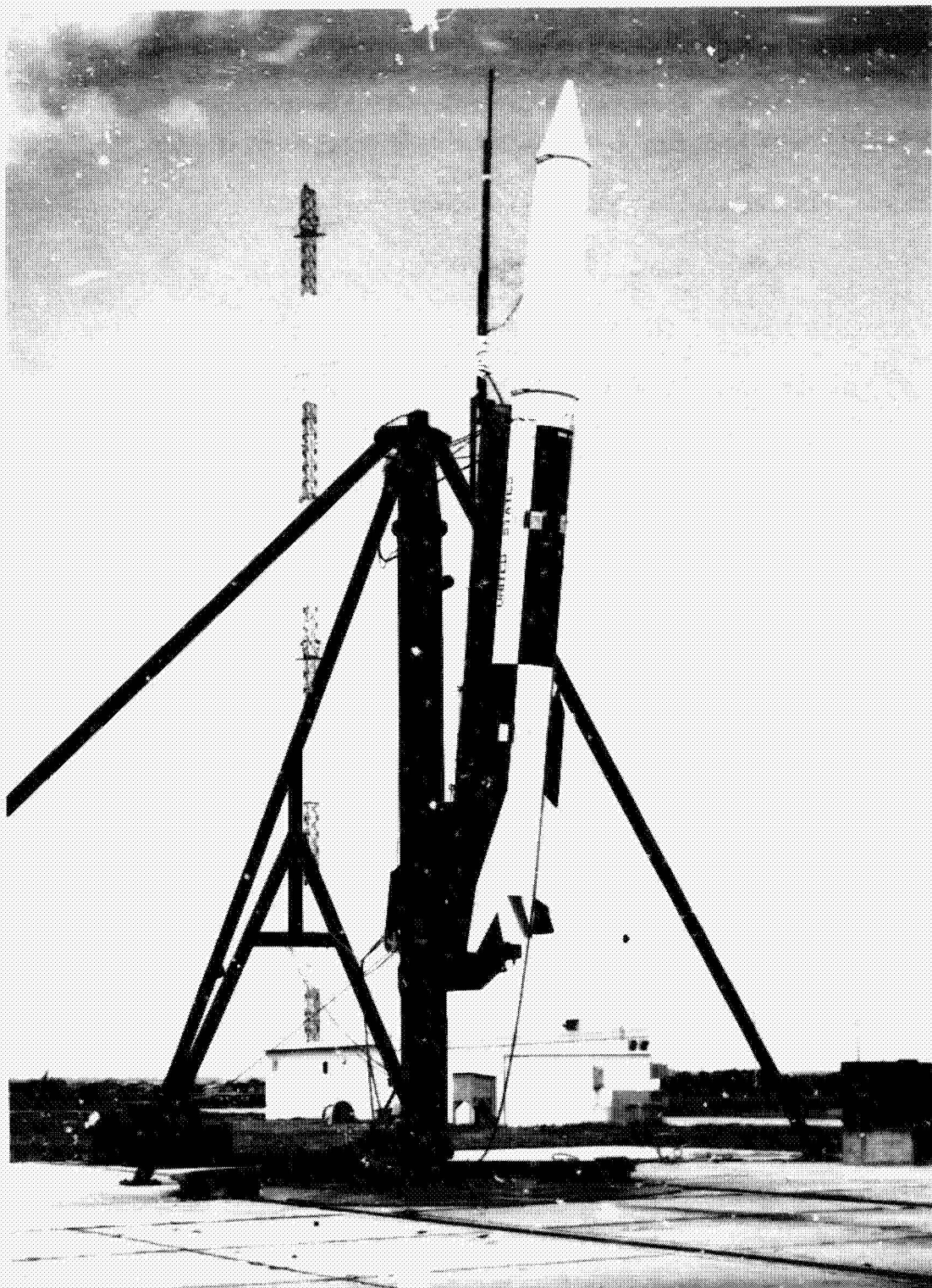
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INSTRUMENTATION DATA  
ASTROBEE 1500, FLIGHT 16.06 GR

INTRODUCTION

The Astrobe 1500, Flight 16.06 GR. was launched from Wallops Island, Virginia, on 15 October 1969, at 22:43:0.236 Greenwich Mean Time. The payload reached a peak altitude of 1390 nautical miles, with the apogee occurring at 43.56 degrees North latitude, and 29.44 degrees West longitude. The impact occurred about 1620 nautical miles down range, at an azimuth angle of 97 degrees from the launch site. Despin and antenna deployment functions were satisfactory, and the telemetered performance was also satisfactory.

The Astrobe 1500 vehicle consists of two stages. The first stage power is provided by an Aerojet solid propellant rocket motor (28KS-57000 Junior). The motor is ignited at lift-off, and burns for 40 seconds, developing an average thrust of 57,000 pounds. Initial thrust is augmented by two Thiokol solid propellant rocket motors (1.5 KS-35000 Recruit). These motors are also ignited at lift-off, and burn for 1.6 seconds, developing an average thrust of 36,000 pounds each.

The 16.06 GR rocket Stage I fins were canted to give a spin rate of two revolutions per second at burnout. At T+54 seconds, four spin-motors (0.5KS-180) were ignited, and added an additional 3.3 revolutions per second to the second stage. At T+55.5 seconds, four explosive bolts were activated, releasing the first stage heat shield.

The power for the second stage is provided by an Aerojet solid propellant rocket motor (23 KS-11,000 Alcor 1B). The Alcor is ignited by an onboard programmer, and burns for 27 seconds, developing an average thrust of 11,000 pounds. At T+56.5 seconds, Stage II ignited, and separated from Stage I.

The purpose of the performance instrumentation was to obtain data pertaining to the magnetic field, to accelerations and vibration, and to pressures, during the progress of the flight, and to transmit the resulting data by PAM/FM/FM telemetry.

The scientific experiment was to measure cosmic radio noise intensities, and to recalibrate the receiver system of the Radio Astronomy Explorer Satellite (RAE-A).

The scientific experiment portion was instrumented by the GSFC Planetary Ionosphere Branch, to measure average cosmic radio noise intensities at 32 frequencies, from 600 kHz to 300 kHz. It consisted of two receivers and two 160 foot (tip to tip) antennas. Resistive and reactive impedance components of the antennas were determined by an impedance probe at eight frequencies. There were also eight thermistor probes, used to monitor the temperatures of the electronic components. It is not, however, the purpose of this report to present any detailed data on the results of the scientific experiment.

Section I of the report contains basic information pertaining to the rocket instrumentation system.

Sections II through IV contain instrumentation data which is necessary for the reduction of the post-flight records, recorded in preparation for the flight. These sections are identified according to the functions of the devices they describe and are accompanied, when applicable, by diagrams showing sensor orientation. Directions of yaw, pitch, and thrust, are shown in reference to the rocket axes.

Section V contains data on calibration and orientation of the antennas.

Section VI contains the test and calibration data, for the instrumentation system, as obtained during preflight tests.

SECTION I  
SYSTEM INFORMATION



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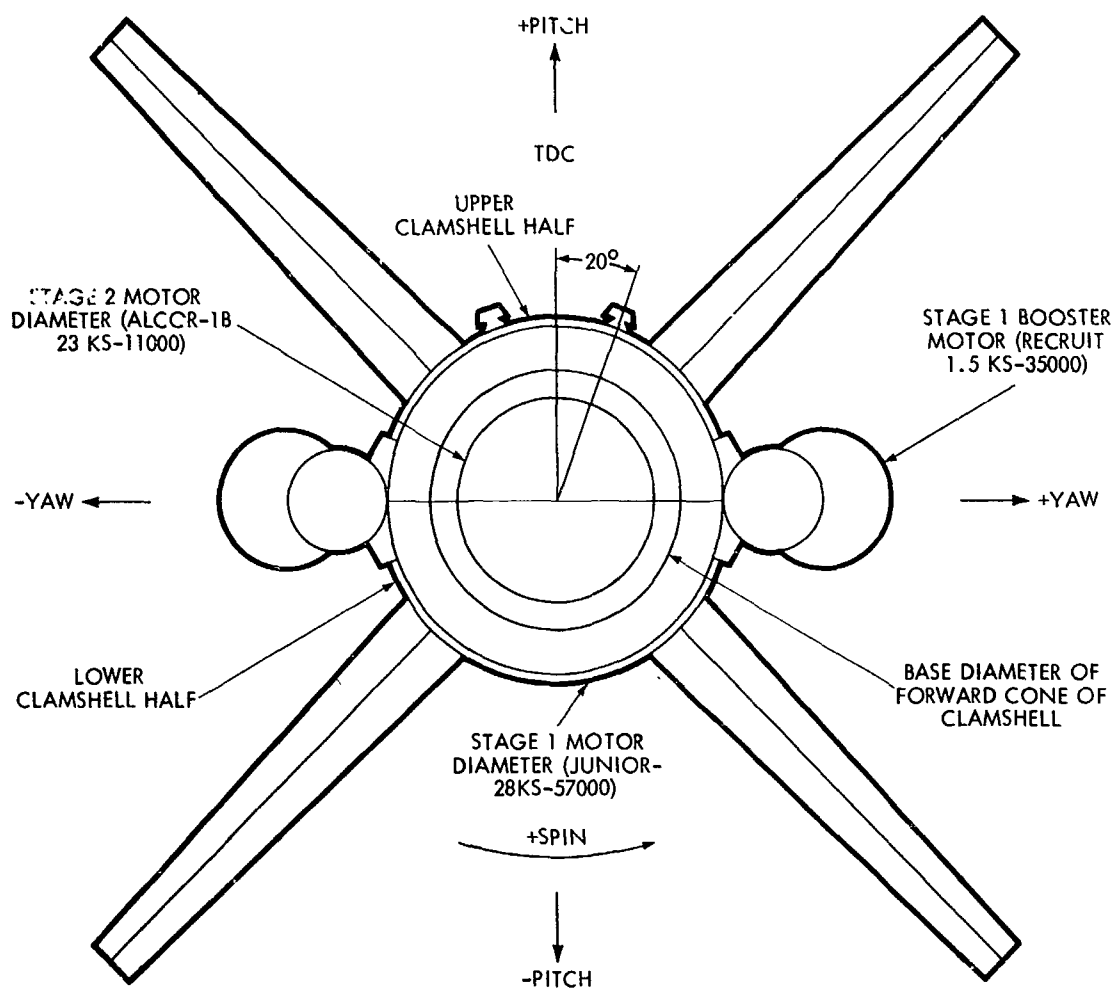


Figure 1. Astrobe 1500 Rocket Axes (looking aft)

TABLE 1  
TELEMETRY SYSTEMS

Telemetry No.	Frequency (MHz)	Measured Power	Deviation (kHz)	Mode of Transmission	Location
1	231.4	8.0 Watts	±125	PAM/FM/FM	Payload
2	256.2	4.3 Watts	±125	PAM/FM/FM	Payload

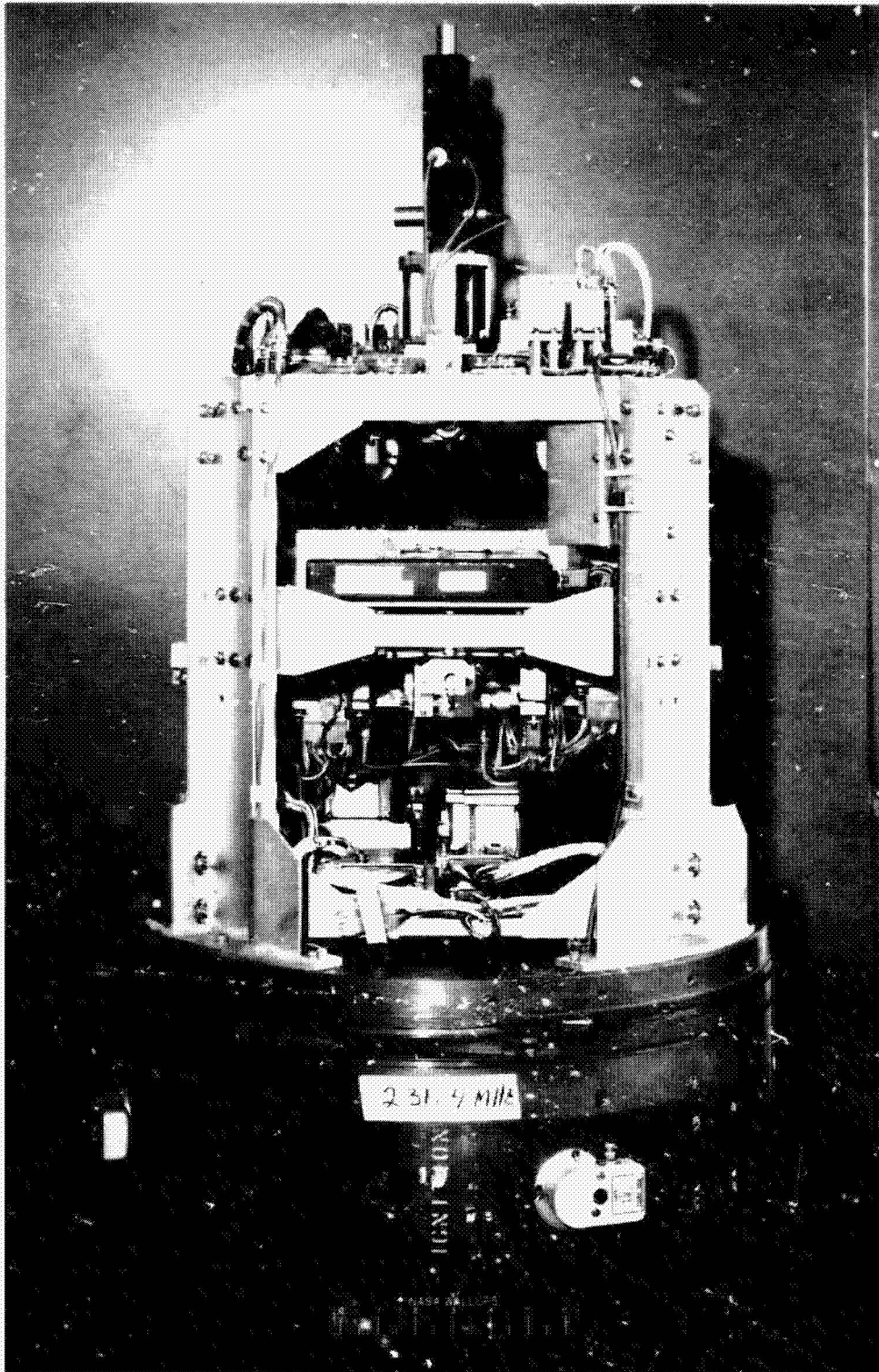


Figure 2. Flight 16.06 GR, Payload View

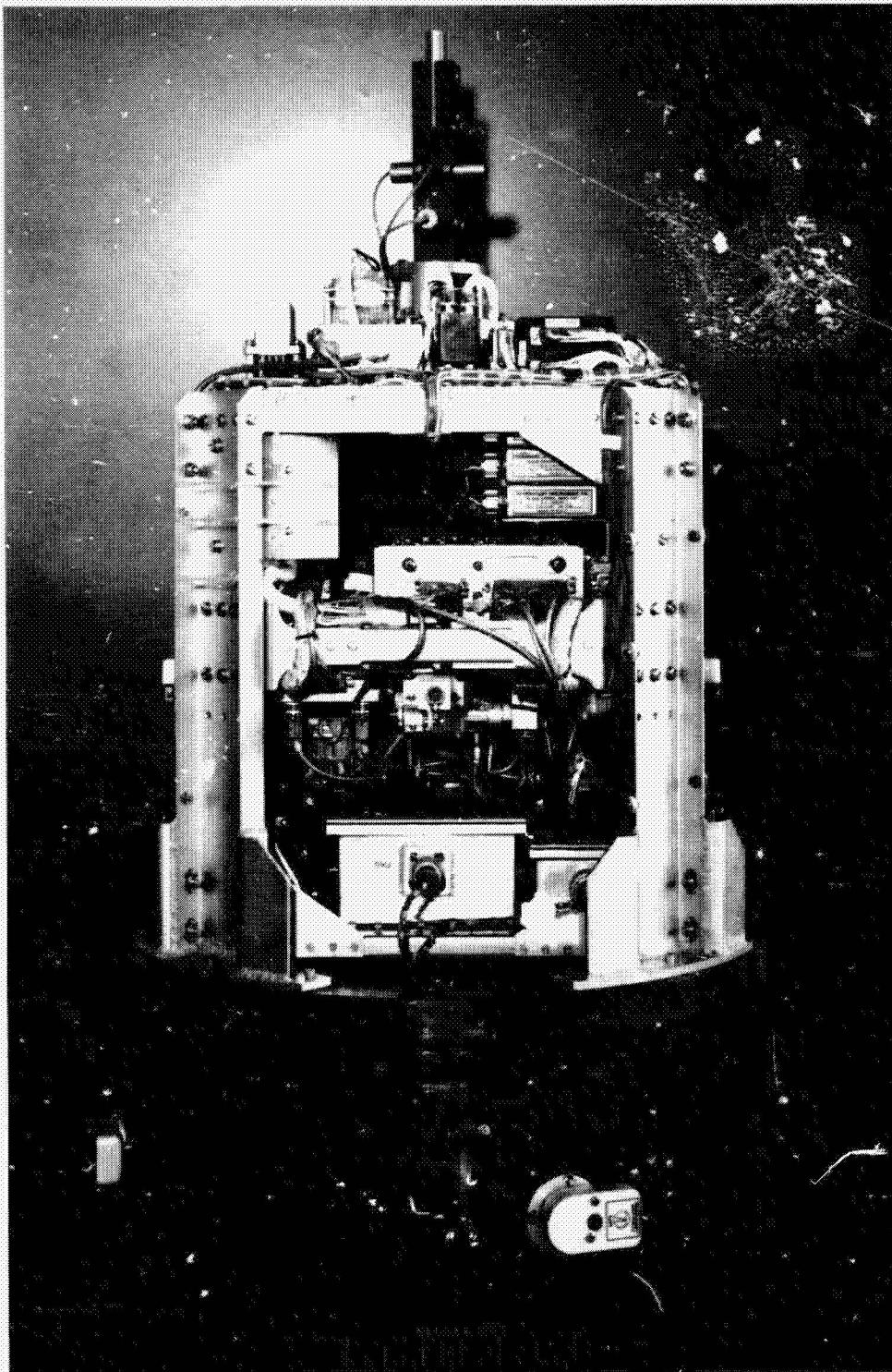


Figure 3. Flight 16.06 GR, Payload View  
(90 degrees from view shown in Figure 2)

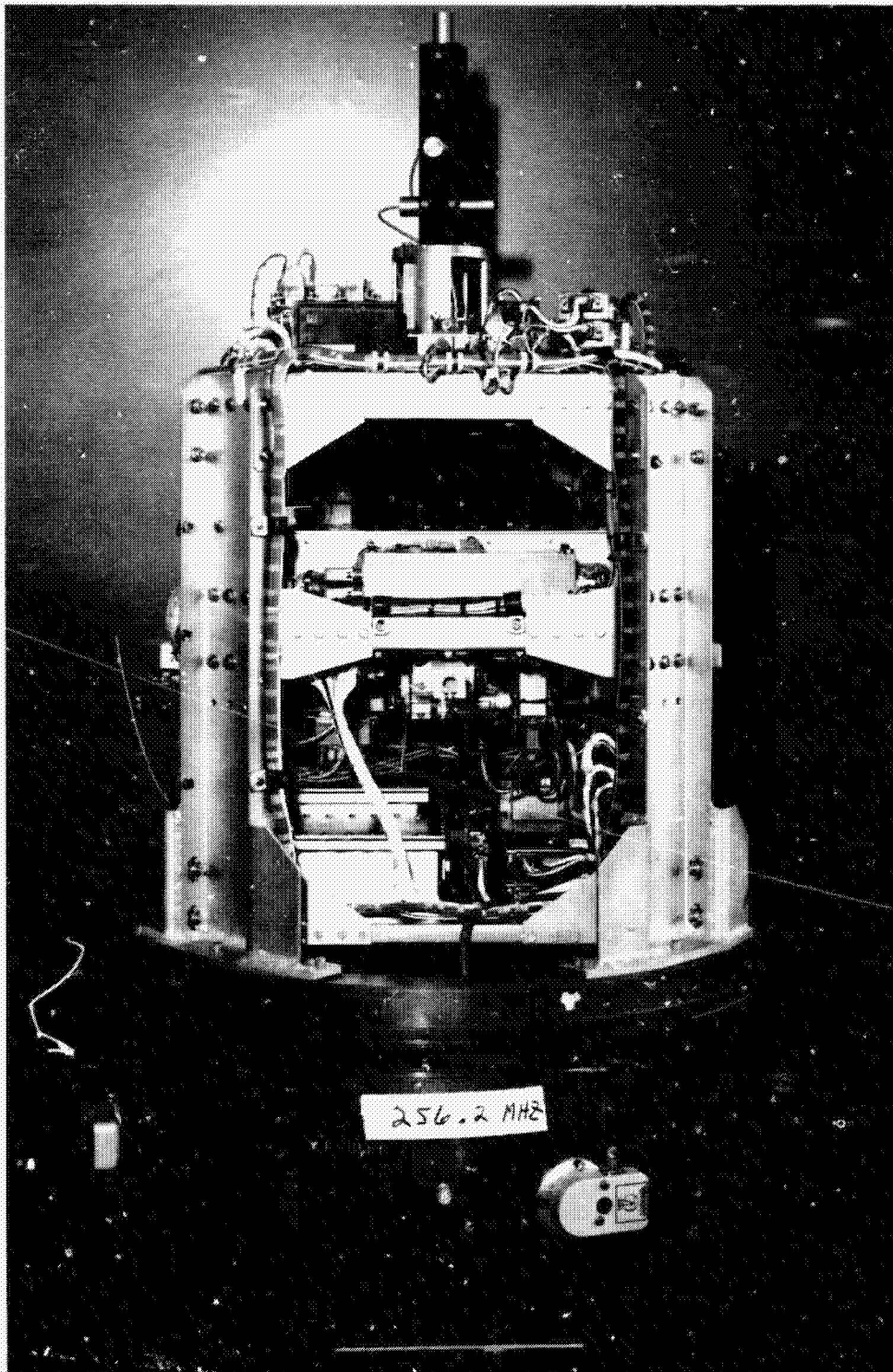


Figure 4. Flight 16.06GR, Payload View  
(180 degrees from view shown in Figure 2)

TABLE 2  
FLIGHT 16.06 GR, COMPONENTS

Component	Manufacturer	Model No.	Serial No.	Remarks
Accelerometer, Yaw (X Axis) Signal Conditioner Unit	Kistler GSFC	303T N/A	1411 1	Acceleration - Yaw
Accelerometer, Pitch (Y Axis) Signal Conditioner Unit	Kistler GSFC	303T N/A	1414 2	Acceleration - Pitch
Accelerometer, Thrust (Z Axis) Signal Conditioner Unit	Kistler GSFC	303T N/A	1413 3	Acceleration - Thrust
Accelerometer-Vibration, Yaw Signal Conditioner Unit	Endevco Endevco	2221E 2640M27	PB64 RA74	Vibration - Yaw
Accelerometer-Vibration, Pitch Signal Conditioner Unit	Endevco Endevco	2221E 2640M27	PB65 RA76	Vibration - Pitch
Accelerometer-Vibration, Thrust Signal Conditioner Unit	Endevco Endevco	2221E 2642M85	PB62 RB05	Vibration - Thrust
Antennas, TM1 (231.4 MHz)	New Mexico State	29.003	Y74, Y75	Performance Telemetry
Antennas, TM2 (256.2 MHz)	New Mexico State	29.003	Y76, Y77	Scientific Telemetry

TABLE 2 (Continued)  
FLIGHT 16.06 GR, COMPONENTS

Component	Manufacturer	Model No.	Serial No.	Remarks
Battery Box	Space Gen. Corp.	N/A	N/A	
Calibrator, TM1	Tempo	90972A	0052	4 Channel Master
Calibrator, TM2	Tempo	90972A	0060	4 Channel Master
Calibrator, TM1	Tempo	90972A-1	0027	6 Channel Slave
Calibrator, TM1	Tempo	90972A-1	0028	6 Channel Slave
Calibrator, TM2	Tempo	90972A-1	0013	6 Channel Slave
Calibrator, TM2	Tempo	90972A-1	0026	6 Channel Slave
Commutator, TM1 - TM2	Datametrics	883	17	
Magnetometer, Yaw (X Axis)	Schonstedt	RAM-5C	2526	
Magnetometer, Pitch (Y Axis)	Schonstedt	RAM-5C	2502	
Magnetometer, Thrust (Z Axis)	Schonstedt	RAM-5C	2524	
Micro-Min. Osc. Mount	Vector	604-14	534	
Micro-Min. Osc. Mount	Vector	604-14	361	

TABLE 2 (Continued)  
FLIGHT 16.06 GR, COMPONENTS

Component	Manufacturer	Model No.	Serial No.	Remarks
Mixer Amplifier, TM1	Vector	MMA11	11656	
Mixer Amplifier, TM2	Vector	MMA11	11903	
Pressure Transducer (PcI) Signal Conditioner Unit	CEC BLH	4-326-0001 950-0003	11481 049	Chamber Pressure
Pressure Transducer, (PcII) Signal Conditioning Unit	CEC BLH	4-326-0001 950-0003	12575 016	Chamber Pressure
Regulator (5 Volts dc)	Vector	TV53-5	1159	
Relay (K101)		BR16-900AS-26 V		
Relay (K102)		BR18AX-C2-V3		
Relay (K103)		BR16-900AS-26V		
Resistor Monitor Board	Space Gen. Corp.			
Sequencer	Space Gen. Corp.			
Squib Monitor Unit	NASA			
Switch (altitude)	Leesona Moos	N/A		

TABLE 2 (Continued)  
FLIGHT 16.06 GR, COMPONENTS

Component	Manufacturer	Model No.	Serial No.	Remarks
Switch (despin)	Leesona Moos	N/A		
Switch (g) No. 1	Raymond	1962-3	132	
Switch (g) No. 2	Raymond	1962-3	103	
Switch (squib)	Atlas			
Switch (thrust pressure)	Aerojet Corp.	2-000613	A-10492	
Timer (g) No. 1	Raymond	1060-5g-3SPDT-90T	12205	
Timer (g) No. 2	Raymond	1060-5g-3SPDT-90T	12187	
Timer (g) No. 3	Raymond	1060-5g-3SPDT-90T	12189	
Timer (g) No. 4	Raymond	1060-5g-3SPDT-90T	12196	
Timer (M1)	Raymond	1060-7g-3SPDT-60T	10201	
Timer (M5)	Raymond	Not Available	—	
Transmitter, TM1	Vector	T-1127	300	
Transmitter, TM2	Vector	T-1127	337	
VCO, TM1 (70.00kHz), IRIG 18	Vector	MM011	16727	Performance Telemetry

TABLE 2 (Continued)  
FLIGHT 16.06 GR, COMPONENTS

Component	Manufacturer	Model No.	Serial No.	Remarks
VCO, TM1 (52.50 kHz), IRIG 17	Vector	MM011	16658	Performance Telemetry
VCO, TM1 (40.00 kHz), IRIG 16	Vector	MM011	5834	Performance Telemetry
VCO, TM1 (30.00 kHz), IRIG 15	Vector	MM011	16382	Performance Telemetry
VCO, TM1 (22.00 kHz), IRIG 14	Vector	MM011	15158	Performance Telemetry
VCO, TM1 (14.50 kHz), IRIG 13	Vector	MM011	7819	Performance Telemetry
VCO, TM1 (10.50 kHz), IRIG 12	Vector	MM011	18690	Performance Telemetry
VCO, TM1 (07.35 kHz), IRIG 11	Vector	MM011	20223	Performance Telemetry
VCO, TM1 (05.40 kHz), IRIG 10	Vector	MM011	15890	Performance Telemetry
VCO, TM1 (03.90 kHz), IRIG 9	Vector	MM011	6608	Performance Telemetry

TABLE 2 (Continued)  
FLIGHT 16.06 GR, COMPONENTS

Component	Manufacturer	Model No.	Serial No.	Remarks
VCO, TM1 (03.00 kHz), IRIG 8	Vector	MM011	15654	Performance Telemetry
VCO, TM1 (02.30 kHz), IRIG 7	Vector	MM011	15539	Performance Telemetry
VCO, TM1 (01.70 kHz), IRIG 6	Vector	MM011	7076	Performance Telemetry
VCO, TM1 (01.30 kHz), IRIG 5	Vector	MM011	10880	Performance Telemetry
VCO, TM1 (00.96 kHz), IRIG 4	Vector	MM011	10856	Performance Telemetry
VCO, TM2 (70.00 kHz), IRIG 18	Vector	MM011	16709	Scientific Telemetry
VCO, TM2 (52.50 kHz), IRIG 17	Vector	MM011	16628	Scientific Telemetry
VCO, TM2 (40.00 kHz), IRIG 16	Vector	MM011	20362	Scientific Telemetry
VCO, TM2 (30.00 kHz), IRIG 15	Vector	MM011	16391	Scientific Telemetry

TABLE 2 (Continued)  
FLIGHT 16.06GR, COMPONENTS

Component	Manufacturer	Model No.	Serial No.	Remarks
VCO, TM2 (22.00 kHz), IRIG 14	Vector	MM011	15177	Scientific Telemetry
VCO, TM2 (14.50 kHz), IRIG 13	Vector	MM011	16206	Scientific Telemetry
VCO, TM2 (10.50 kHz), IRIG 12	Vector	MM011	18778	Scientific Telemetry
VCO, TM2 (07.35 kHz), IRIG 11	Vector	MM011	20230	Scientific Telemetry
VCO, TM2 (05.40 kHz), IRIG 10	Vector	MM011	20206	Scientific Telemetry
VCO, TM2 (03.90 kHz), IRIG 9	Vector	MM011	15769	Scientific Telemetry
VCO, TM2 (03.00 kHz), IRIG 8	Vector	MM011	5050	Scientific Telemetry
VCO, TM2 (02.30 kHz), IRIG 7	Vector	MM011	15515	Scientific Telemetry
VCO, TM2 (01.70 kHz), IRIG 6	Vector	MM011	7084	Scientific Telemetry

TABLE 3  
SIGNIFICANT PLANNED EVENTS FOR FLIGHT 16.06 GR

Event	Predicted Time (seconds)	Actual* Time (seconds)	Predicted Altitude (feet)	Predicted Range (feet)	Predicted Velocity (ft. per sec.)
Stage I Ignition	0.0	-0.045	0	0	0
Lift Off, and Thrust Pressure Switch (make)	0.0	0.0	0	0	0
Recruit Booster Burnout	2.13	1.64**	612	120	544
Thrust Pressure Switch (break)		32.295			
Stage I Burnout	40.0	36.065	119,550	41,790	6,310
Spin Rockets Fire (electrical)	54.0	53.261			
Bolts Fire (electrical)	55.0	54.364			
Spin Rockets Fire (mechanical)	54.5	54.510			
Stage II Ignition	56.5	56.339	212,495	77,442	5,804
Stage I Separation		56.365***			
Stage II Burnout	83.5	82.707	532,700	214,619	19,571
Guillotine No. 1 (Despin)	88.0	87.776	568,424	230,051	19,515

TABLE 3 (Continued)  
SIGNIFICANT PLANNED EVENTS FOR FLIGHT 16.06 GR

Event	Predicted Time (seconds)	Actual* Time (seconds)	Predicted Altitude (feet)	Predicted Range (feet)	Predicted Velocity (ft. per sec.)
Guillotine No. 2 (Despin)	88.0	87.895	568,424	230,051	19,515
Timer (g), No. 4 (Monitor)	90.0	89.824	604,059	245,424	19,459
Timer (g), No. 3 (Monitor)	90.0	90.028	604,059	245,424	19,459
Timer (g), No. 2 (Monitor)	90.0	90.038	604,059	245,424	19,459
Timer (g), No. 1 (Monitor)	90.0	90.042	604,059	245,424	19,459
Antenna Deployment (Start)	90.0	90.028	604,059	245,424	19,459
End of Antenna Deployment	250.0	219.0	2,557,654	1,074,878	16,429
Stage I Impact	485.0		0	892,693	561
Payload Apogee	1089.0		8,615,508†	4,832,367	4,962
Payload Impact	2201.9		0	9,668,140††	279

\*Actual event times are from commutated telemetry data.

\*\*Web Burn through.

\*\*\*Stage II pressure = 234 psia.

† Actual payload apogee = 8,450,000 feet.

†† Actual payload impact = 9,830,000 feet.

TABLE 3 (Continued)  
SIGNIFICANT PLANNED EVENTS FOR FLIGHT 16.06 GR

	<u>Predicted</u>	<u>Actual</u>
Roll Rate at Stage I Burnout	= 2.0 r/s	1.90 r/s
Roll Rate at Stage II Burnout	= 5.0 r/s	5.23 r/s
Roll Rate at Post Despin	= 1.0 r/m	10.50 r/m
Roll Rate after Antenna Deploy.	= 1.0 r/m	0.47 r/m
	<u>Actual</u> <u>Latitude</u>	<u>Actual</u> <u>Longitude</u>
Stage I Impact	= 38.09 N	72.38 W
Payload Apogee	= 43.56 N	29.44 W
		Effective launch azimuth = 90.0 degrees Effective launch elevation = 80.0 degrees

TABLE 4  
IRIG BAND ALLOCATIONS, PAM/FM/FM TELEMTRY SYSTEM 1  
(231.4 MHz)

IRIG Band	IRIG Freq. (kHz)	Frequency Response (Hz)	Allocation	Range	Remarks
18	70.00	1050	Vibration, Thrust Axis	±20 g	PcII  5 r/s  PcI
17	52.50	790	Vibration, Yaw Axis	±10 g	
16	40.00	600	Vibration, Pitch Axis	±10 g	
15	30.00	450	Stage II Pressure (Chamber)	0 to 600 psia	
14	22.00	330	Commutator (Performance Telem.)		
13	14.50	220	Stage I Pressure (Chamber)	0 to 600 psia	
12	10.50	160	Acceleration, Thrust Axis	0 to 50 g	
11	7.35	110	Acceleration, Yaw Axis	±7.5 g	
10	5.40	80	Acceleration, Pitch Axis	±7.5 g	
9	3.90	60	Magnetometer, Roll Axis	±600 milligauss	
8	3.00	45	Magnetometer, Pitch Axis	±600 milligauss	Range RCVR Multi- plex
7	2.30	35	Magnetometer, Yaw Axis	±600 milligauss	
6	1.70	25	Receiver No. 1 Data		
5	1.30	20	Receiver No. 2 Data		
4	0.96	14	Receivers No. 1 and No. 2		

TABLE 5  
IRIG BAND ALLOCATIONS, PAM/FM/FM TELEMETRY SYSTEM 2  
(256.2 MHz)

IRIG Band	IRIG Freq. (kHz)	Frequency Response (Hz)	Allocation	Remarks
18	70.00	1050	Fine Scale Voltage	Z Probe
17	52.50	790	Fine Scale Current	Z Probe
16	40.00	600	Fine Scale Phase Angle	Z Probe
15	30.00	450	Coarse Scale Phase Angle	Z Probe
14	22.00	330	Commutator (Scientific)	5 r/s
13	14.50	220	Coarse Scale Current	Z Probe
12	10.50	160	Coarse Scale Voltage	Z Probe
11	7.35	110	Receiver 1 (data)	
10	5.40	80	Receiver 2 (data)	
9	3.90	60	Receiver 1 (Frequency Monitor)	
8	3.00	45	Receiver 2 (Frequency Monitor)	
7	2.30	35	Receiver 1 (Range)	
6	1.70	25	Receiver 2 (Range)	

TABLE 6  
COMMUTATOR SEGMENT ALLOCATIONS  
TELEMETRY SYSTEM 1, CHANNEL 14 (22 kHz), 5.0 r/s

Segment	Allocation	Nominal Value	
		Preflight	Flight
1	Ground	0.000	0.000
2	Thrust Pressure Switch (make)	0.000	4.716
3	Thrust Pressure Switch (break)	0.000	4.435
4	Spin-Rocket Fire (elect./mech.)	0.000	3.638*
5	Explosive-Bolt Fire	0.000	3.461
6	Explosive-Bolt Fire, B/U	0.000	2.256
7	Stage II Ignition	0.000	3.730
8	Despin Weight Release 1	0.895	3.860
9	Despin Weight Release 2	0.944	3.799
10	Despin Cable Cutter 1 (Cur. M.)	0.367	0.367**
11	Despin Cable Cutter 2 (Cur. M.)	0.360	0.360**
12	g Timer 4 (Monitor)	0.842	3.625
13	g Timer 3 (Monitor)	0.854	3.834
14	g Timer 2 (Monitor)	0.868	3.760
15	g Timer 1 (Monitor)	0.917	3.759
16	+28 Volts dc Instrumentation (Monitor)	3.858	3.858***
17	Thrust Pressure Switch (make)	0.000	4.716

\* $E_a = E_3 + E_4$

\*\*Positive Pulse

\*\*\*@30.00 Volts dc

TABLE 6 (Continued)  
COMMUTATOR SEGMENT ALLOCATIONS  
TELEMETRY SYSTEM 1, CHANNEL 14 (22 kHz), 5.0 r/s

Segment	Allocation	Nominal Value	
		Preflight	Flight
18	Thrust Pressure Switch (break)	0.000	4.435
19	Spin-Rocket Fire (elect./mech.)	0.000	3.638
20	Explosive-Bolt Fire	0.000	3.461
21	Explosive-Bolt Fire, B/U	0.000	2.256
22	Stage II Ignition	0.000	3.730
23	+2.5 Volts dc (Calibration)	2.494	2.494*
24	Magnetometer Bias, Pitch Axis	2.396	2.396
25	Magnetometer Bias, Yaw Axis	2.400	2.400
26	Magnetometer Bias, Roll Axis	2.397	2.397
27	Stage I Pressure (BLH Monitor)	0.504	0.504**
28	Stage II Pressure (BLH Monitor)	0.501	0.501***
29	+5 Volts dc (Frame Sync)	5.000	5.001
30	+5 Volts dc (Frame Sync)	5.001	5.001

\*@30.00 Volts dc

\*\*PcI

\*\*\*PcII

TABLE 7  
COMMUTATOR SEGMENT ALLOCATIONS  
TELEMETRY SYSTEM 2, CHANNEL 14 (22 kHz), 5.0 r/s

Segment	Allocation	Nominal Value
1	Ground	
2	+2.5 Volts dc (Calibration)	Experiment
3	Temperature Sensor, T1	Experiment
4	Temperature Sensor, T2	Experiment
5	Temperature Sensor, T3	Experiment
6	Temperature Sensor, T4	Experiment
7	Temperature Sensor, T5	Experiment
8	Temperature Sensor, T6	Experiment
9	Temperature Sensor, T7	Experiment
10	Temperature Sensor, T8	Experiment
11	Antenna 1 (Length Monitor)	Experiment
12	Antenna 1 (Limit Switch Monitor)	Experiment
13	Antenna 2 (Length Monitor)	Experiment
14	Antenna 2 (Limit Switch Monitor)	Experiment
15	Antenna 3 (Length Monitor)	Experiment
16	Antenna 3 (Limit Switch Monitor)	Experiment
17	Antenna 4 (Length Monitor)	Experiment
18	Antenna 4 (Limit Switch Monitor)	Experiment
19	Receiver 1 (Voltage Reg. Mon.)	±6 Volts dc

TABLE 7 (Continued)  
 COMMUTATOR SEGMENT ALLOCATIONS  
 TELEMETRY SYSTEM 2, CHANNEL 14 (22 kHz), 5.0 r/s

Segment	Allocation	Nominal Value
20	Impedance Probe, Flag 1	Experiment
21	Receiver 2 (Voltage Reg. Mon.)	±6 Volts ac
22	Programmer (Voltage Reg. Mon.)	±18 Volts dc
23	Impedance Probe, Flag 2	Experiment
24	Programmer (Voltage Reg. Mon.)	±6 Volts dc
25	Impedance Probe (Volt. Reg. Monitor)	±12 Volts dc
26	Programmed Noise-Generator Flag	Experiment
27	Impedance Probe (Volt. Reg. Monitor)	±12 Volts dc
28	Relay (+25 Volts Reg. Mon.)	
29	+5 Volts dc (Frame Sync)	
30	+5 Volts dc (Frame Sync)	

TABLE 8  
SCIENTIFIC INTERFACE CONNECTOR ALLOCATIONS (CANNON D550)

Pin No.	Allocation
1	Receiver 1 (data)
2	Receiver 2 (data)
3	Receiver 1 (Frequency Monitor)
4	Receiver 2 (Frequency Monitor)
5	Receiver 1 (Range)
6	Receiver 2 (Range)
7	+28 Volts dc Supply
8	Temperature Sensor, T1
9	Temperature Sensor, T2
10	Temperature Sensor, T3
11	Temperature Sensor, T4
12	Temperature Sensor, T5
13	Temperature Sensor, T6
14	Temperature Sensor, T7
15	Temperature Sensor, T8
16	Antenna 1 (Length Monitor)
17	Antenna 1 (Limit Switch Monitor)
18	Antenna 2 (Length Monitor)
19	Antenna 2 (Limit Switch Monitor)

TABLE 8 (Continued)  
SCIENTIFIC INTERFACE CONNECTOR ALLOCATIONS (CANNON D550)

Pin No.	Allocation
20	Antenna 3 (Length Monitor)
21	Antenna 3 (Limit Switch Monitor)
22	Antenna 4 (Length Monitor)
23	Antenna 4 (Limit Switch Monitor)
24	Antennas 1 and 3, Deployment Command (+6 Volts dc)
25	Antennas 2 and 4, Deployment Command (+6 Volts dc)
26	Impedance Probe, Flag 1
27	Impedance Probe, Flag 2
28	Coarse Scale Voltage
29	Coarse Scale Current
30	Coarse Scale Phase Angle
31	Fine Scale Voltage
32	Fine Scale Current
33	Fine Scale Phase Angle
34	Antennas 1 and 3, Deployment Command (+6 Volts dc)
35	Antennas 2 and 4, Deployment Command (+6 Volts dc)
36	Receiver 1 (+6 Volts dc Regulator Monitor)
37	Receiver 2 (+6 Volts dc Regulator Monitor)
38	Programmer (+18 Volts dc Regulator Monitor)
39	Programmed Noise-Generator Flag

TABLE 8 (Continued)  
SCIENTIFIC INTERFACE CONNECTOR ALLOCATIONS (CANNON D550)

Pin No.	Allocation
40	Ground
41	+28 Volts dc Supply
42	-28 Volts dc Supply
43	Ground
44	Ground
45	Ground
46	Programmer (+6 Volts dc Regulator Monitor)
47	Impedance Probe ( $\pm 12$ Volts dc Regulator Monitor)
48	Impedance Probe (+18 Volts dc Regulator Monitor)
49	Relay (25 Volts dc Regulator Monitor)
50	-28 Volts dc Supply

TABLE 9  
PAYLOAD UMBILICAL CONNECTOR, PIN ALLOCATIONS (P46)

Pin Letter	Allocation	Umbilical No. 2 Pin No.	Patch No.
A	g Timer No. 1, Monitor	1	A-15
B	g Timer No. 2, Monitor	2	B-15
C	g Timer No. 3, Monitor	3	C-15
D	g Timer No. 4, Monitor	4	D-15
E	Despin Squib-Battery No. 1, Monitor and Charge	5	E-15
F	Despin Squib-Battery No. 2, Monitor and Charge	6	F-15
G	Despin Squib-Battery No. 1, Return	7	G-15
H	Despin Squib-Battery No. 2, Return	8	H-15
J	Ground, Power Supply	9	J-15
K	Ground, Power Supply	10	K-15
L	Instrumentation, External Power (+28 Volts dc)	11	L-15
M	Commutator, External Power	12	M-15
N	Telemetry No. 2, External Power	13	N-15
P	Internal Power ON (Instrumentation, Commutator, Telemetry No. 2)	14	P-15
R	Internal Power OFF (Instrumentation, Commutator, Telemetry No. 2)	15	Q-15
S	Experiment, External Power (-24 Volts dc)	16	R-15

TABLE 9 (Continued)  
PAYLOAD UMBILICAL CONNECTOR, PIN ALLOCATIONS (P46)

Pin Letter	Allocation	Umbilical No. 2 Pin No.	Patch No.
T	Telemetry No. 1, External Power (+28 Volts dc)	17	S-15
U	Scientific Experiment, External Power (+28 Volts dc)	18	T-15
V	Internal Power ON, (Scientific Experiment, Telemetry No. 1) (-24 Volts dc)	19	A-15
W	Internal Power OFF, Scientific Experiment, Telemetry No. 1) (-24 Volts dc)	20	B-16
X	Spare	21	C-16
Y	Spare	22	D-16
Z	Spare	23	E-16
a	g Switch No. 1, Instrumentation Volt Meter (+30 Volts dc)	24	F-16
b	g Switch No. 2, Experiment Battery Monitor (-24 Volts dc)	25	G-16
c	Ground, Calibrate Control	26	H-16
d	Instrumentation, Battery Charge (+28 Volts dc)	27	J-16
e	Battery Charge (-28 Volts dc)	28	K-16
f	Battery Charge, Antenna (+12 Volts dc)	29	L-16
g	Battery Charge, Antenna (+12 Volts dc)	30	M-16
h	Monitor Ground	31	N-16

TABLE 10  
INTERSTAGE UMBILICAL CONNECTOR,  
PIN ALLOCATIONS (P2)

Pin Letter	Allocation
A	Disarm
B	Control Battery (+)
C	Arm
D	Arm
E	Disarm
F	Control Battery (-)
G	Spare
H	Spare
J	Spare
K	Spare
L	Spare
M	Spare
N	Spare
P	Spare
R	Spare
S	Spare
T	Spare
U	Spare
V	Spare

TABLE 11  
ORDNANCE BATTERY-CHARGE UMBILICAL  
CONNECTOR, PIN ALLOCATIONS (P43)

Pin No.	Allocation
1	Ordnance Battery Charge, B4 (+)
2	Ordnance Battery Charge, B4 (-)
3	Ordnance Battery Charge, B2 (+)
4	Ordnance Battery Charge, B2 (-)
5	Spare
6	Spare
7	Ordnance Battery Charge, B3 (-)
8	Ordnance Battery Charge, B3 (+)
9	Ordnance Battery Charge, B5 (-)
10	Ordnance Battery Charge, B5 (+)
11	Ordnance Battery Charge, B1 (-)
12	Ordnance Battery Charge, B1 (+)
13	Ordnance Battery Charge, B6 (-)
14	Ordnance Battery Charge, B6 (+)
15	Spare
16	Spare
17	Spare
18	Spare
19	Spare

TABLE 12  
STATION 1, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, Main Base)

TAPE RECORDER 1	
14 Inch Reel, 0.5 Inch Width, 60 ips Speed	
Track No.	Allocation
1	Voice, and Tape Speed Compensation (100 kHz)
2	36 Bit Timing
3	TM 1 Video (231.4 MHz)
4	TM 2 Video (256.2 MHz)
5	TM 1 Video (231.4 MHz)
6	TM 2 Video (256.2 MHz)
7	Servo Control (17 kHz), and Station Multiplex*

\*STATION MULTIPLEX

36 Bit Timing (70.0kHz)	TM 1 (231.4MHz), AGC (30.0kHz)
28 Bit Timing (52.5 kHz)	TM 2 (256.2MHz), AGC (14.5kHz)
Voice (40.0kHz)	

TAPE RECORDER 2
Same as Tape Recorder 1 (used as backup recorder)

TABLE 12 (Continued)  
STATION 1, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, Main Base)

PAPER RECORDER 1	
Telemetry Transmitter No. 1 (231.4 MHz)	
T-60 Seconds to T+100 Seconds = 10 ips	
T+100 Seconds to Loss of Signal = 1 ips	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Static Trace
3	Thrust Vibration (70.0 kHz), IRIG 18
4	Yaw Vibration (52.5 kHz), IRIG 17
5	Pitch Vibration (40.0 kHz), IRIG 16
6	Static Trace
7	Thrust Acceleration (10.5 kHz), IRIG 12
8	Yaw Acceleration (7.35 kHz), IRIG 11
9	Pitch Acceleration (5.4 kHz), IRIG 10
10	Static Trace
11	36 Bit, Range Timing (NASA)

TABLE 12 (Continued)  
STATION I, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, Main Base)

PAPER RECORDER 2	
Telemetry Transmitter No. 1 (231.4 MHz)	
T-60 Seconds to T+100 Seconds = 10 ips	
T+100 Seconds to Loss of Signal = 1 ips	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Static Trace
3	Stage I Pressure (PcI) (14.5 kHz), IRIG 13
4	Stage II Pressure (PcII) (30.0 kHz), IRIG 15
5	Commutator (22.0 kHz), IRIG 14
6	Static Trace
7	Roll Magnetometer (3.9 kHz), IRIG 9
8	Pitch Magnetometer (3.0 kHz), IRIG 8
9	Yaw Magnetometer (2.3 kHz), IRIG 7
10	Dudley Observatory Experiment (1.7 kHz), IRIG 6
11	Static Trace
12	36 Bit, Range Timing (NASA)

TABLE 12 (Continued)  
STATION I, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, Main Base)

PAPER RECORDER 3	
Telemetry Transmitter No. 2 (256.2 MHz)	
T-60 Seconds to Loss of Signal = 1 ips	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Static Trace
3	Z Probe, Fine Scale Voltage (70.0 kHz), IRIG 18
4	Z Probe, Coarse Scale Voltage (10.5 kHz), IRIG 12
5	Z Probe, Fine Scale Current (52.5 kHz), IRIG 17
6	Static Trace
7	Z Probe, Coarse Scale Current (14.5 kHz), IRIG 13
8	Z Probe, Fine Scale Phase Angle (40.0 kHz), IRIG 16
9	Z Probe, Coarse Scale Phase Angle (30.0 kHz), IRIG 15
10	Static Trace
11	28 Bit, Range Timing (NASA)

TABLE 12 (Continued)  
STATION I, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, Main Base)

PAPER RECORDER 4	
Telemetry Transmitter No. 2 (256.2 MHz)	
T-60 Seconds to Loss of Signal = 1 ips	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Static Trace
3	Commutator (22.0 kHz), IRIG 14
4	Receiver No. 1, Data (7.35 kHz), IRIG 11
5	Receiver No. 1, Frequency Monitor (3.9 kHz), IRIG 9
6	Receiver No. 1, Range (2.3 kHz), IRIG 7
7	Static Trace
8	Receiver No. 2, Data (5.4 kHz), IRIG 10
9	Receiver No. 2, Frequency Monitor (3.0 kHz), IRIG 8
10	Receiver No. 2, Range (1.7 kHz), IRIG 6
11	Static Trace
12	28 Bit, Range Timing (NASA)

TABLE 12 (Continued)  
STATION I, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, Main Base)

DECOMMUTATION RECORDER A	
Telemetry No. 2 (256.2 MHz), Channel 14 (22.0 kHz), 5 r/s	
T-60 Seconds to Loss of Signal = 5 mm/sec.	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Temperature Sensor, T1 (Segment 3)
3	Temperature Sensor, T2 (Segment 4)
4	Temperature Sensor, T3 (Segment 5)
5	Temperature Sensor, T4 (Segment 6)
6	Temperature Sensor, T5 (Segment 7)
7	Temperature Sensor, T6 (Segment 8)
8	Temperature Sensor, T7 (Segment 9)
9	Temperature Sensor, T8 (Segment 10)
10	28 Bit, Range Timing (NASA)

DECOMMUTATION RECORDER B	
Telemetry No. 2 (256.2 MHz), Channel 14 (22.0 kHz), 5 r/s	
T-60 Seconds to Loss of Signal = 5 mm/sec.	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Antenna No. 1, Length Monitor (Segment 11)
3	Antenna No. 1, Limit Switch (Segment 12)
4	Antenna No. 2, Length Monitor (Segment 13)
5	Antenna No. 2, Limit Switch (Segment 14)
6	Antenna No. 3, Length Monitor (Segment 15)
7	Antenna No. 3, Limit Switch (Segment 16)
8	Antenna No. 4, Length Monitor (Segment 17)
9	Antenna No. 4, Limit Switch (Segment 18)
10	28 Bit, Range Timing (NASA)

TABLE 12 (Continued)  
STATION I, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, Main Base)

DECOMMUTATION RECORDER C	
Telemetry No. 2 (256.2 MHz), Channel 14 (22.0 kHz), 5 r/s	
T-60 Seconds of Loss of Signal = 5 mm/sec.	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Receiver No. 1, Voltage Regulator Monitor ( $\pm 6$ Volts dc) (Segment 19)
3	Receiver No. 2, Voltage Regulator Monitor ( $\pm 6$ Volts dc) (Segment 21)
4	Programmer, Voltage Regulator No. 1 Monitor ( $\pm 18$ Volts dc) (Segment 22)
5	Programmer, Voltage Regulator No. 2 Monitor ( $\pm 18$ Volts dc) (Segment 24)
6	Relay, Voltage Regulator Monitor ( $\pm 25$ Volts dc) (Segment 28)
7	28 Bit, Range Timing (NASA)

TABLE 12 (Continued)  
STATION I, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, Main Base)

DECOMMUTATION RECORDER D	
Telemetry No. 2 (256.2 MHz), Channel 14 (22.0 kHz), 5 r/s	
T-60 Seconds to Loss of Signal = 5 mm/sec.	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Z Probe, Voltage Regulator No. 1, Monitor ( $\pm 12$ Volts dc) (Segment 25)
3	Z Probe, Voltage Regulator No. 2, Monitor ( $\pm 18$ Volts dc) (Segment 27)
4	Z Probe, Flag No. 1 (Segment 20)
5	Z Probe, Flag No. 2 (Segment 23)
6	Programmed Noise-Generator Flag (Segment 26)

TABLE 13  
STATION II, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, GSFC Station A)

TAPE RECORDER 1A	
14 Inch Reel, 0.5 Inches Width, 60 ips Speed	
Track No.	Allocation
1	Voice, and Tape Speed Compensation (100 kHz)
2	36 Bit Timing
3	TM 1 Video (231.4 MHz)
4	TM 2 Video (256.2 MHz)
5	TM 1 Video (231.4 MHz)
6	TM 2 Video (256.2 MHz)
7	Servo Control (17 kHz), and Station Multiplex*

**\*STATION MULTIPLEX**

Tape Speed Compensation (100kHz)  
36 Bit Timing (70kHz)  
28 Bit Timing (52.5kHz)

Voice (40kHz)  
TM 1 (231.4MHz), AGC (30.0kHz)  
TM 2 (256.2MHz), AGC (22.0kHz)

TAPE RECORDERS 2A, and 3A
Same as Tape Recorder 1A (used as backup recorders)

Paper Recorders 1A and 2A are same as Station I Paper Recorders No. 1 and No. 2
--

TABLE 13 (Continued)  
STATION II, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, GSFC Station A)

PAPER RECORDER 3A	
Telemetry Transmitter No. 2 (256.2 MHz)	
T-60 Seconds to Loss of Signal = 1 ips	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Static Trace
3	Z Probe, Fine Scale Voltage (70.0 kHz), IRIG 18
4	Z Probe, Coarse Scale Voltage (10.5 kHz), IRIG 12
5	Z Probe, Fine Scale Current (52.5 kHz), IRIG 17
6	Z Probe, Coarse Scale Current (14.5 kHz), IRIG 13
7	Z Probe, Fine Scale Phase Angle (40.0 kHz), IRIG 16
8	Z Probe, Coarse Scale Phase Angle (30.0 kHz), IRIG 15
9	Receiver No. 1, Data (7.35 kHz), IRIG 11
10	Receiver No. 1, Frequency Monitor (8.9 kHz), IRIG 9
11	Receiver No. 1, Range (2.3 kHz), IRIG 7
12	Receiver No. 2, Data (5.4 kHz), IRIG 10
13	Receiver No. 2, Frequency Monitor (3.0 kHz), IRIG 8
14	Receiver No. 2, Range (1.7 kHz), IRIG 6
15	Static Trace
16	36 Bit, Range Timing (NASA)

TABLE 13 (Continued)  
 STATION II, RECORDER CHANNEL ALLOCATIONS  
 (Wallops Island, GSFC Station A)

DECOMMUTATION RECORDER A	
Telemetry No. 1 (231.4 MHz), Channel 14 (22.0 kHz), 5 r/s	
T-60 Seconds to Loss of Signal = 5 mm/sec.	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Thrust Pressure Switch (make), (Segments 2 and 17)
3	Thrust Pressure Switch (break), (Segments 3 and 18)
4	Spin-Rocket Fire (Segments 4 and 19)
5	Explosive-Bolt Fire (Segments 5 and 20)
6	Explosive-Bolt Fire B/U (Segments 6 and 21)
7	Stage II Ignition (Segments 7 and 22)
8	28 Bit, Range Timing (NASA)

TABLE 13 (Continued)  
STATION II, RECORDER CHANNEL ALLOCATIONS  
(Wallops Island, GSFC Station A)

DECOMMUTATION RECORDER B	
Telemetry No. 1 (231.4 MHz), Channel 14 (22.0 kHz), 5 r/s	
T-60 Seconds to Loss of Signal = 5 mm/sec.	
Galvanometer No.	Allocation
1	28 Bit, Range Timing (NASA)
2	Despin Weight Release No. 1 (Segment 8)
3	Despin Weight Release No. 2 (Segment 9)
4	Despin Cable Cutter No. 1 (Segment 10)
5	Despin Cable Cutter No. 2 (Segment 11)
6	g Timer No. 4 (Segment 12)
7	g Timer No. 3 (Segment 13)
8	g Timer No. 2 (Segment 14)
9	g Timer No. 1 (Segment 15)
10	28 Bit, Range Timing (NASA)

TABLE 14  
STATION III, RECORDER CHANNEL ALLOCATIONS  
(Glendale, Maryland)

TAPE RECORDINGS ONLY
Allocations are the same as Station I at Wallops Island

STATION IV, RECORDER CHANNEL ALLOCATIONS  
(Bermuda, W. I.)

TAPE RECORDINGS ONLY
Allocations are the same as Station I at Wallops Island

TABLE 15  
WEIGHTS, PAYLOAD CENTER OF GRAVITY,  
AND MOMENTS OF INERTIA

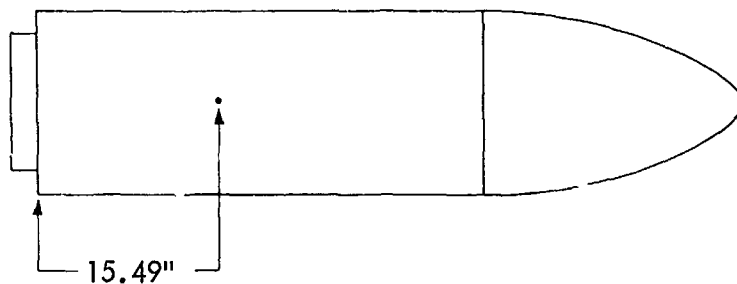
	Planned	Actual
Payload	Pounds	Pounds
Total Payload Weight	105	104.6

Stage II	Pounds	Pounds
Inert Weight	109	113.2
Propellant	918	918.1
Total Stage II Weight at Ignition (with Payload)	1,027	1,135.9
Total Stage II Weight at Burnout (with Payload)	214	217.8

TABLE 15 (Continued)  
WEIGHTS, PAYLOAD CENTER OF GRAVITY, AND MOMENTS OF INERTIA

	Planned	Actual
Stage I	Pounds	Pounds
Inert Weight	2,552	2,553.0
Propellant (Jr. and Recruits)	8,024	8,014.5
Total Stage I Weight at Ignition	10,576	11,703.4
Total Stage I Weight at Burnout	3,684	3,688.9

Summary Weights	Pounds	Pounds
Weight at Launch	11,708	11,703.4
Weight at Stage I Burnout	3,684	3,688.9
Weight at Stage II Ignition	1,132	1,135.9
Weight at Stage II Burnout	214	217.8



Center of Gravity = 15.49 Inches from the Aftmost Payload Surface

Moments of Inertia

Spin = 1.15 Slug Feet<sup>2</sup>

Lateral (Pitch) = 2.25 Slug Feet<sup>2</sup>

Lateral (Yaw) = 2.27 Slug Feet<sup>2</sup>

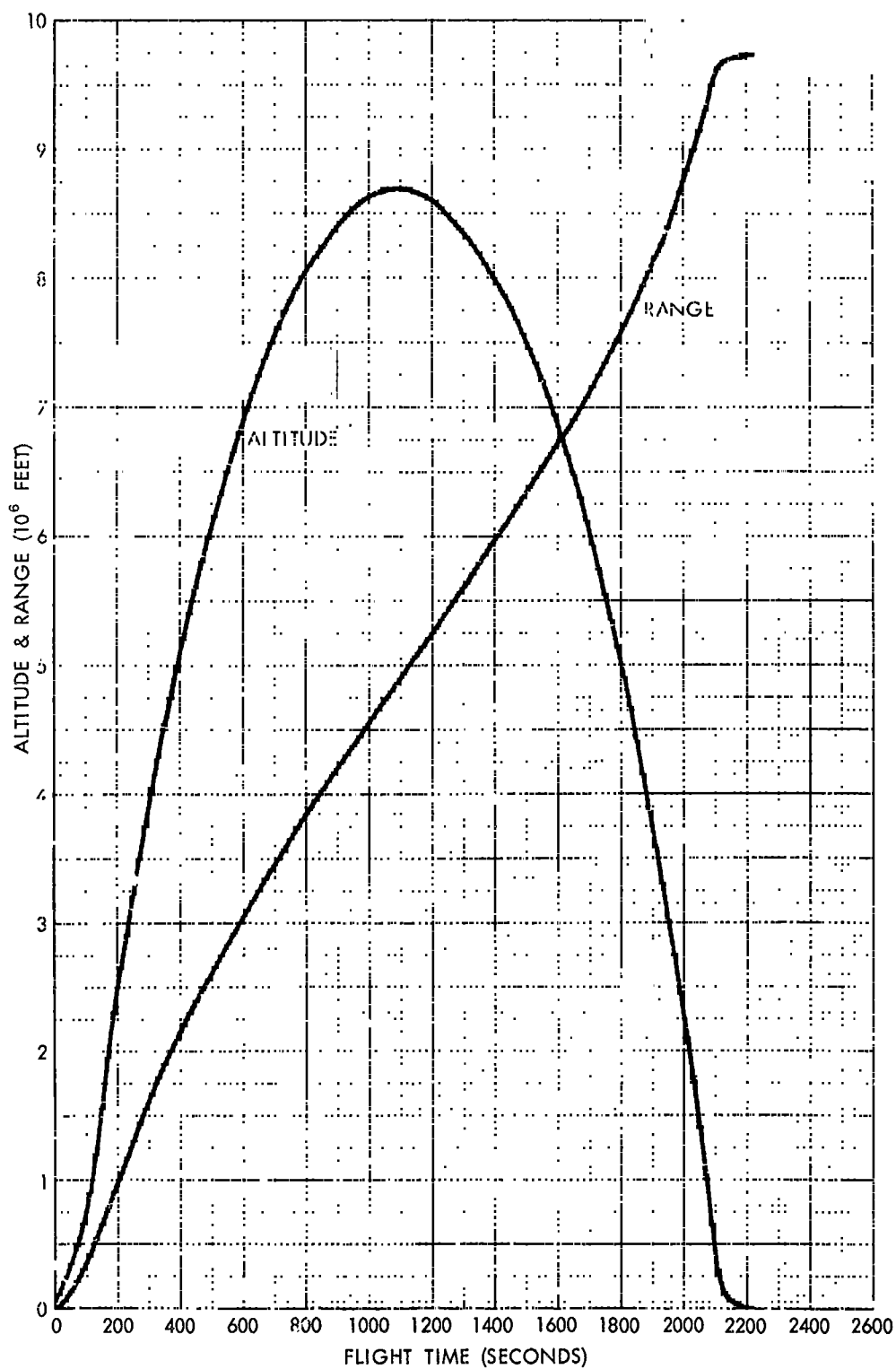


Figure 5. Flight 16.06GR, Flight Profile Curves

TABLE 16  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Minus			Item No.	Operation
Hour	Min.	Sec.		
4	00	00	1	Launch balloon with corner-reflector attached, and track to maximum altitude with Radar.
			2	Vehicle is completely installed on the Tubular Launcher in Launch Area No. 4.
			3	Photographers take documentary stills of the vehicle in horizontal position.
			4	Have Ionsonde Station make a sweep every 15 minutes.
3	30	00	5	Turn Payload warmup buss ON.
3	20	00	6	Establish ignition silence at Main Base Station, and Station "A."
			7	Close, and clear, launch pad for Payload checks. Confirm.
3	15	00	8	Turn Telemetry No. 1, and Telemetry No. 2, External Power ON.
			9	Turn Telemetry Commutators External Power ON.
			10	Begin horizontal Payload checks. (Radars standby for RFI checks)
3	00	00	11	Payload horizontal checks complete. Discontinue ignition silence. Payload control verify that the Payload checks are good before vehicle elevation.
2	50	00	12	GE-625 computer and Wallops radars conduct pointing angle checks with Bermuda.

TABLE 16 (Continued)  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Minus			Item No.	Operation
Hour	Min.	Sec.		
2	50	00	13	Elevate vehicle to nominal setting of 40 degree (with azimuth set at 82 degrees True).
			14	Photographers take documentary stills of vehicle in vertical position.
2	05	00	15	Re-establish ignition silence at Main Base Station, and Station "A."
			16	Close, and clear, launch pad for Payload checks. Confirm.
2	00	00	17	Begin vertical Payload checks.
			18	Release balloon with corner-reflector attached, and track to 20,000 feet with Radar.
			19	Air Traffic Coordinator contact FAA and MATS, and receive traffic report.
			20	Bermuda Coordinator establish SCAMA link with the Bermuda Telemetry and Radar Stations, for communication check, and relay count status.
1	45	00	21	Payload vertical checks completed. Discontinue ignition silence.
			22	All Payload power OFF.
1	35	00	23	Establish road-blocks at warning light No. 8, and traffic light No. 4. Position barricades across all access roads that intersect the Old Island Road, between the aforementioned road-blocks (as close to the new By-Pass Road as practicable), and hold for the first five minutes of battery charging.

2

TABLE 16 (Continued)  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Minus			Item No.	Operation
Hour	Min.	Sec.		
1	30	00	24	Payload-Control, confirm Payload GO (before the battery charging begins).
			25	Close, and clear, launch area. Confirm. Begin charging vehicle ordnance batteries at the rate of 0.5 amperes for 1 hour.
			26	Begin releasing chaff balloons, at the rate of ten minute intervals, and track to 6,000 feet altitude with Radar.
1	25	00	27	Release battery-charging road-blocks, after an O. K. from Pad supervisor.
1	00	00	28	Release balloon with corner-reflector attached, and track to 10,000 feet with Radar.
			29	Air Traffic coordinator contact FAA and MATS for a traffic report.
0	45	00	30	Time Count
0	35	00	31	Re-establish road-blocks for test rocket. (See item 23).
0	30	00	32	Launch a standard 2.75-inch test rocket from Launch Area No. 4. Have back-up test rockets available at Launch Area No. 4, and Launch Area No. 2.
			33	Release road-blocks, on O. K. from Pad supervisor.
			34	Vehicle ordnance battery-charging, and load checks complete. Confirm.
			35	Bermuda coordinator establish "Hot Line" on SCAMA with Bermuda Telemetry and Radar Stations.

TABLE 16 (Continued)  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Minus			Item No.	Operation
Hour	Min.	Sec.		
			36	Air Traffic coordinator establish "Hot Line" w FAA and MATS.
			37	Have Ionosonde Station make a sweep every 5 minutes.
0	25	00	38	Time Count.
0	20	00	39	Turn Payload warmup buss ON.
			40	Begin final launcher settings.
0	15	00	41	Time Count.
0	10	00	42	Time Count.
0	09	00	43	Time Count.
0	08	00	44	Final Launcher settings complete.
			45	Re-establish road-blocks for launch. (See item 23.)
			46	Re-establish ignition silence at Main Base Station, and Station "A."
0	07	00	47	Clear launch area for launch.
			48	All stations stand by for station checks.
			49	Announce Launcher, and Launch Area to be used.
0	06	00	50	Time Count.
0	05	00	51	If the Project Manager considers it necessary to call a "HOLD", required by a specific launch window, the "HOLD" will be called at this time.

TABLE 16 (Continued)  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Minus			Item No.	Operation
Hour	Min.	Sec.		
0	05	00	52	Count resumed. Telemetry No. 1, and Telemetry No. 2 External Power ON.
			53	Telemetry tape recorders ON.
			54	Commutators External Power ON.
			55	Station checks: ALL STATIONS ACKNOWLEDGE.
				Blockhouse No. 3
				Radar No. 1
				Radar No. 3
				Radar No. 4
				Radar No. 5
				Radar No. 6
				Camera No. 2
				Camera No. 4
				Camera No. 5
				Camera No. 9
				Main Base Telemetry
				Station "A"
				GE-625 Computer
				Bermuda Telemetry
				Bermuda Radars
				Wallops Island Ionosonde Station
				Payload Control
				Project Manager
				Pad Supervisor
				Range Clearance
				Range Control Center

TABLE 16 (Continued)  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Minus			Item No.	Operation
Hour	Min.	Sec.		
			56	Ionosonde Station go into continuous sweep of once every minute.
0	04	00	57	Calibrate Payload.
0	03	00	58	HOLD COUNT.
			59	Project Scientist and Payload-Control confirm "All Systems Go" over Channel 2.
			60	After confirmation from the Range Control Center, manually pull two of the four umbilical connectors.  1. Shorting Plug (P3). 2. Battery Charging Plug (P43).
			61	The Pad supervisor will confirm on Channel 2 that all launch pad personnel have returned to the blockhouse.
			62	Prepare to resume count to meet launch time.
0	03	00	63	Resume count, and confirm from Range Control Center.
0	02	00	64	All Payload systems Internal Power ON.
0	01	00	65	Turn Telemetry paper recorders ON. (1 inch per sec.)
			66	Payload launch-control confirm that Payload control console is all GREEN.
			67	Ionosonde Station discontinue sweeps. Remain off the air until Payload impact.
0	00	50	68	Time Count.
0	00	40	69	Time Count.

TABLE 16 (Continued)  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Minus			Item No.	Operation
Hour	Min.	Sec.		
0	00	30	70	ARM vehicle ignition circuits, and confirm over Channel No. 2.
			71	Telemetry paper recorders go to high speed of 10 inches per second.
0	00	20	72	Time Count.
0	00	15	73	Time Count.
0	00	10	74	Time Count.
0	00	09	75	Time Count.
0	00	08	76	Time Count.
0	00	07	77	Calibrate Payload. In case of a "HOLD" because of calibration, upon request of Control-Center, recycle the master programmer to minus 30 seconds and "HOLD." Resume count when directed, at a time to enable launch to occur on an even minute.
0	00	06	78	Time Count.
0	00	05	79	Time Count.
0	00	04	80	Time Count.
0	00	03	81	Time Count.
0	00	02	82	Time Count.
0	00	01	83	Bomb Tone ON (heard on 3105 kHz, and Channel 2).
0	00	00	84	Bomb Tone OFF.

TABLE 16 (Continued)  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Plus			Item No.	Operation
Hour	Min.	Sec.		
0	00	00	85	Stage I (Aerojet Jr.) fires. Two Recruit motors fired by maypole circuit.
			86	Two umbilical connectors disengaged at lift-off. 1. Payload (P46). 2. Vehicle Control (P2).
			87	g actuated mechanical timers started, for: 1. Interstage door release, and spin motor ignition. 2. Stage II ignition. 3. Antenna deployment
			88	Electronic timer is Armed, when Stage I motor pressure reaches 200 psia.
0	00	01	89	Time Count.
0	00	02	90	Two Recruit motors burn out (2.13 seconds), and remain attached to Stage I.
0	00	03	91	Time Count.
0	00	04	92	Time Count.
0	00	05	93	Time Count.
0	00	06	94	Time Count.
0	00	07	95	Time Count.
0	00	08	96	Time Count.
0	00	09	97	Time Count.

TABLE 16 (Continued)  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Plus			Item No.	Operation
Hour	Min.	Sec.		
0	00	10	98	Time Count.
0	00	15	99	Time Count.
0	00	20	100	Time Count.
0	00	25	101	Time Count.
0	00	30	102	Time Count.
0	00	34	103	Electronic timer starts when Stage I motor pressure decays to 200 psia.
0	00	35	104	Time Count.
0	00	40	105	Stage I burns out, and remains attached to Stage II. Spin rate at this time is 2 r/s.
0	00	50	106	Time Count.
0	00	54	107	Interstage doors are released by pin pullers, and spin motors are fired by the electronic timer, or by the mechanical timer backup system.
			108	Pin pulls, tripping the interlock in Stage II ignition circuits.
			109	Pin pulls, starting the explosive-bolt mechanical timer.
0	00	54.5	110	Spin motors burn out.
0	00	55	111	Explosive-bolts fire, by electronic timer or by mechanical timer backup system, releasing the clamshell heat shield.

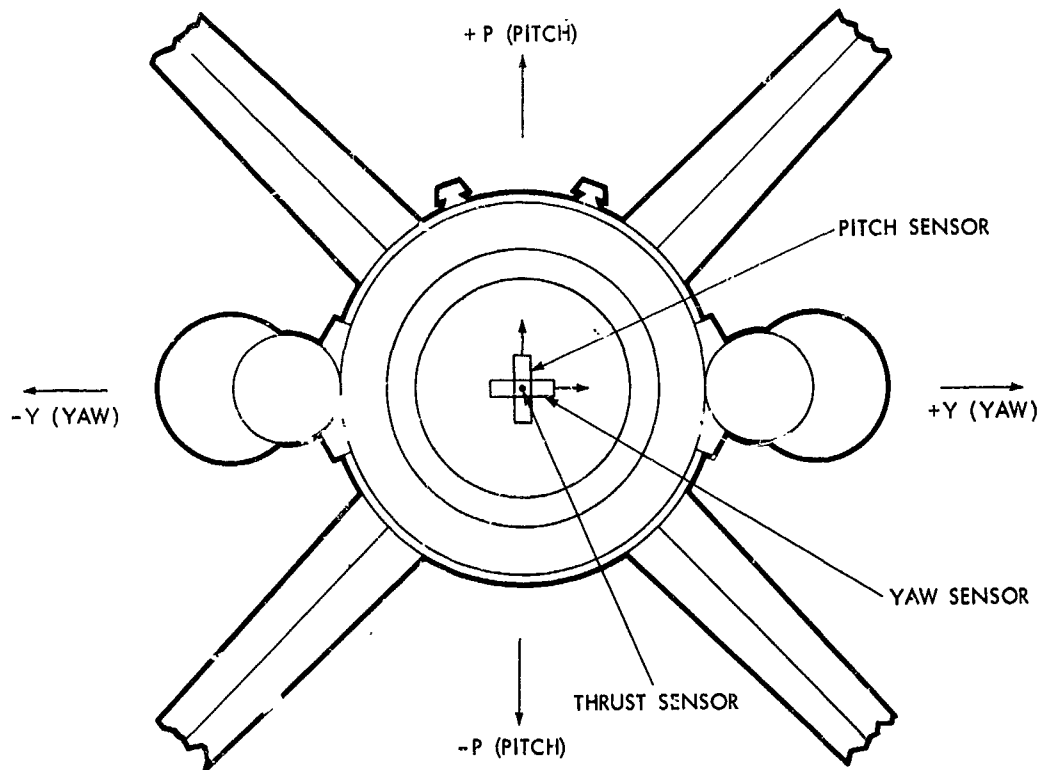
TABLE 16 (Continued)  
FLIGHT 16.06 GR, LAUNCH COUNTDOWN

T Plus			Item. No.	Operation
Hour	Min.	Sec.		
0	00	56.5	112	Stage II Alcor motor ignites, by electronic timer or by mechanical timer backup system, and blast-separates from Stage I.
			113	Payload telemetry signals may be temporarily lost at this time.
0	01	00	114	Time Count.
0	01	26.5	115	Stage II burns out, and remains attached to Payload. Spin rate at this time is 5 r/s.
0	01	28	116	The timer controlled cable cutter releases the Yo Yo despin system, which reduces the Stage II Payload roll rate from 5 r/s to 1 r/m.
0	01	30	117	Four experiment boom-antennas (80 feet each) begin deployment, by timer-controlled motors.
0	02	00	118	Release post-launch wind balloon, if needed.
0	02	30	119	Time Count.
0	03	00	120	Time Count.
0	03	55	121	Stage I apogee occurs at 110 nautical miles.
0	04	00	122	Time Count. Continue count at 30 second intervals until Stage II Payload impact.
0	08	05	123	Stage I impact occurs at 146.8 nautical miles.
0	18	09	124	Stage II Payload apogee occurs at 1417 nautical miles.
0	36	42	125	Stage II Payload impact occurs at 1590 nautical miles.
			126	Release roadblocks.
			127	Ionosonde Station sweep at 5 min. intervals until 20 min. after impact, then 15 min. interval sweeps.

SECTION II  
VEHICLE ASPECT DATA



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NOTE: ALL THREE SENSORS ARE SINGLE AXIS

Figure 6. Magnetic Aspect Sensors, Orientation in Flight 15.06 GR  
(looking aft)

TABLE 17  
MAGNETIC ASPECT SENSORS

Sensor	Manufacturer	Model No.	Serial No.	Full Scale Range
Sensor, Yaw	Schonstedt	RAM-5C	2526	±600 milligauss
Sensor, Pitch	Schonstedt	RAM-5C	2502	±600 milligauss
Sensor, Thrust	Schonstedt	RAM-5C	2524	±600 milligauss

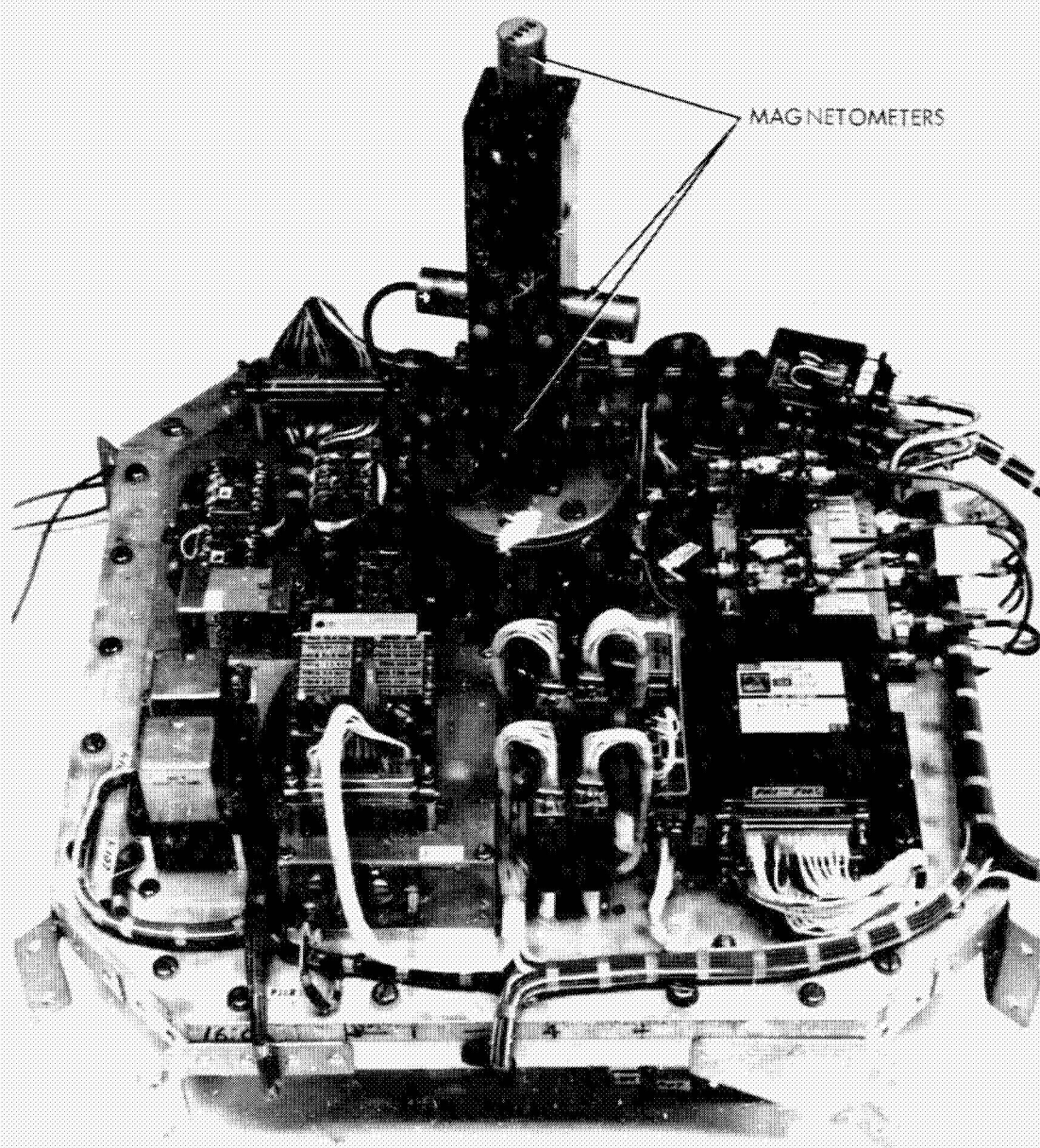


Figure 7. Magnetometer Installation

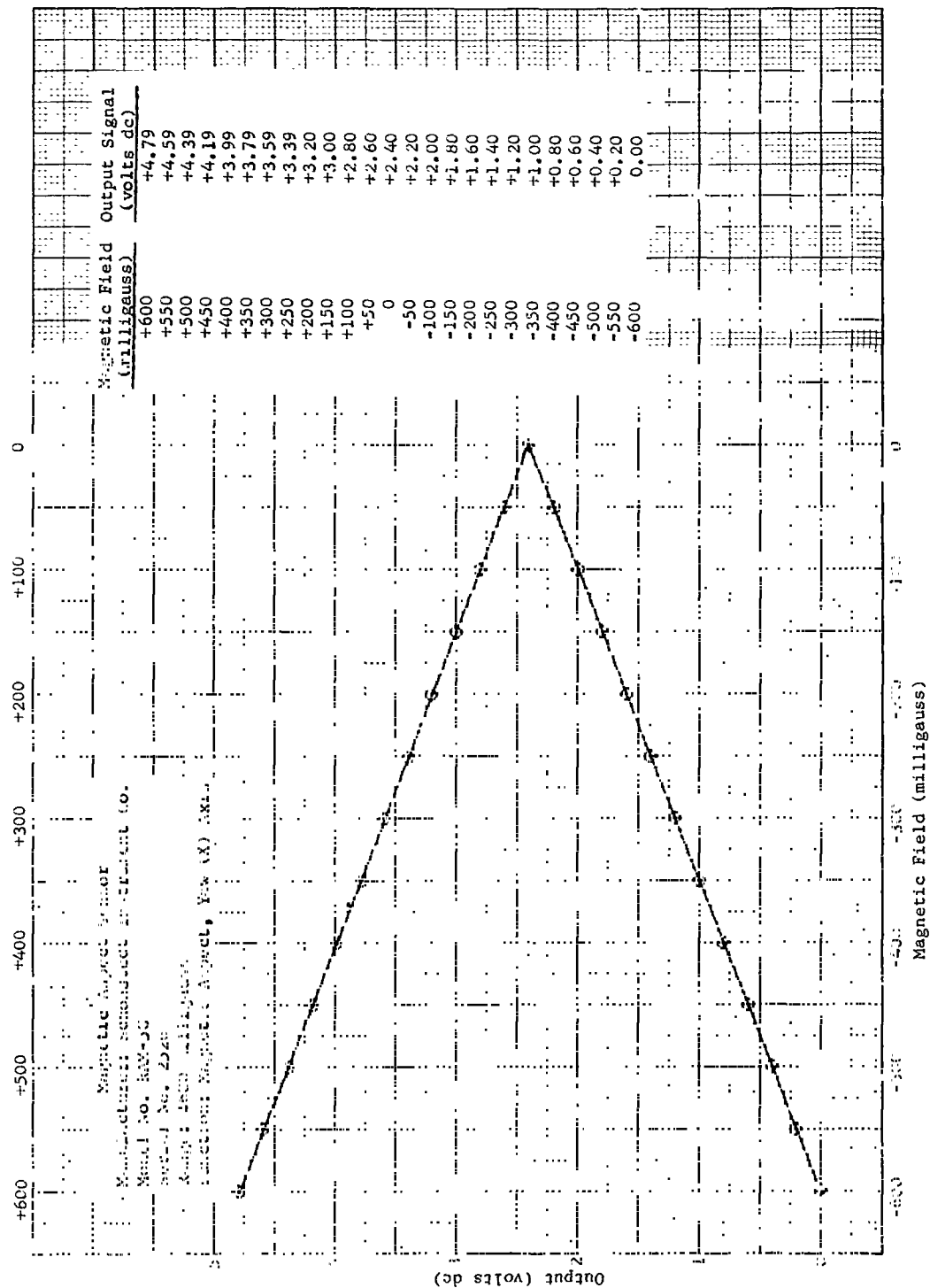


Figure 8. Magnetic Aspect Sensor, Calibration Curve for Yaw (X) Axis

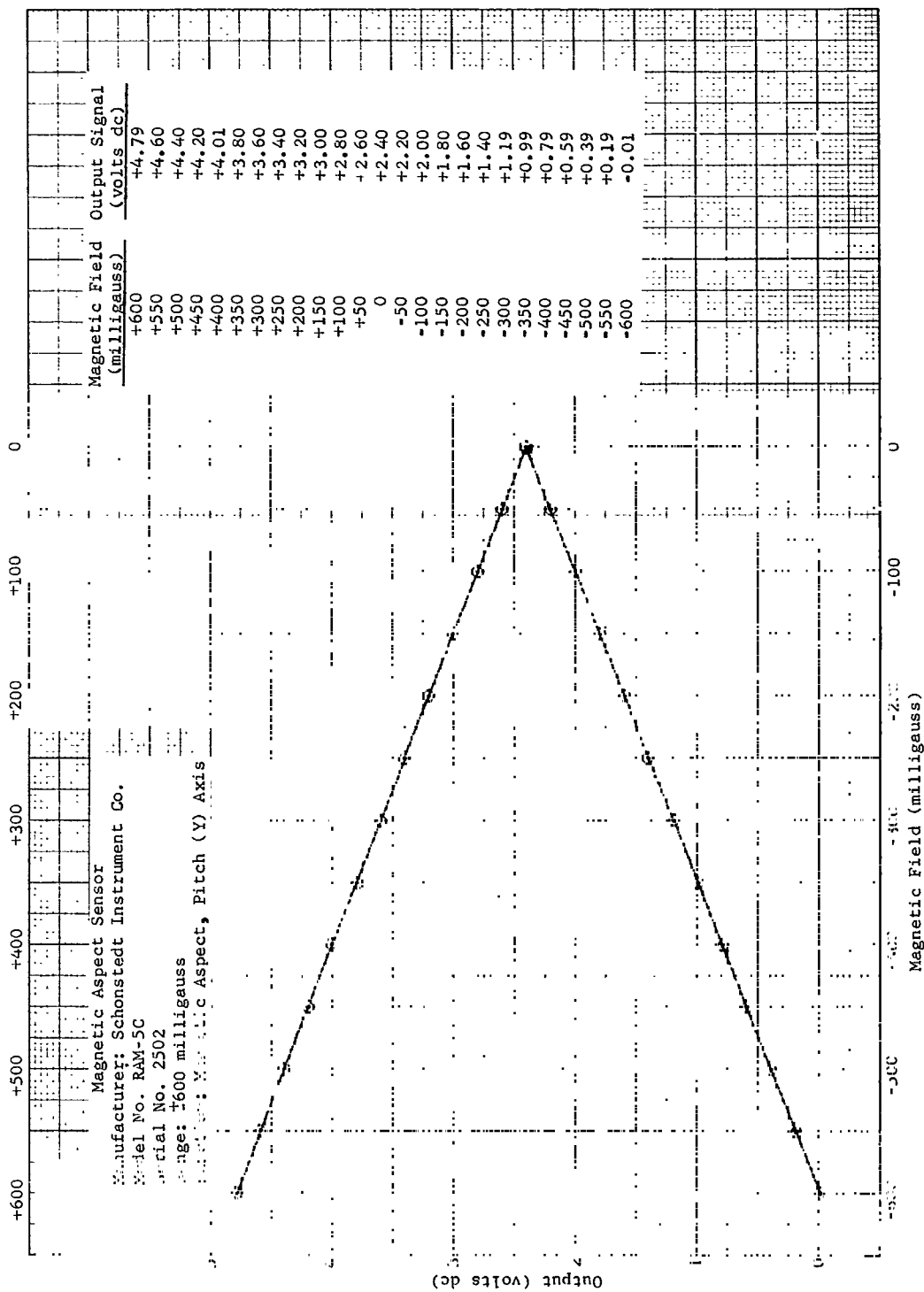


Figure 9. Magnetic Aspect Sensor, Calibration Curve for Pitch (Y) Axis

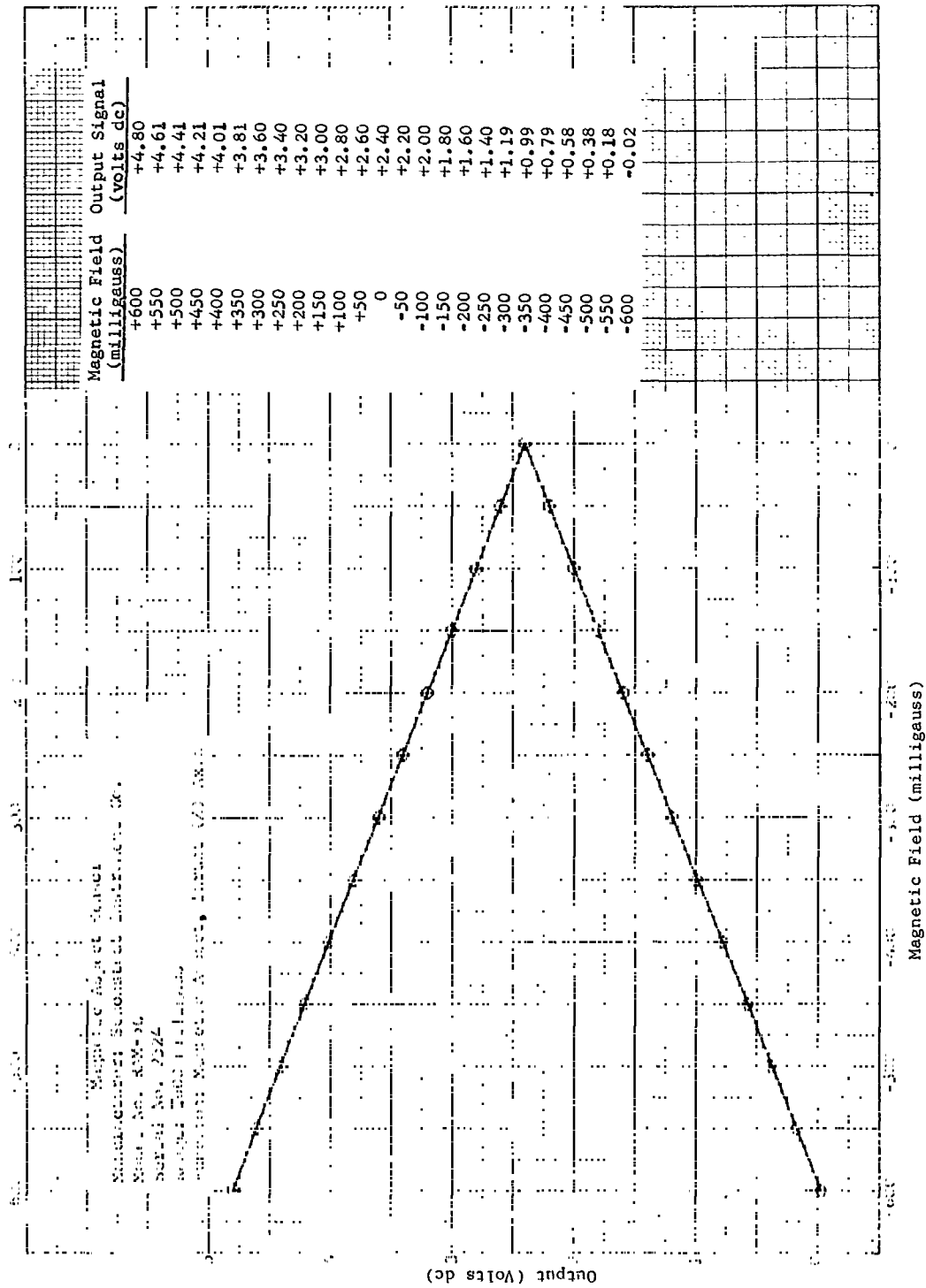


Figure 10. Magnetic Aspect Sensor, Calibration Curve for Thrust (Z) Axis

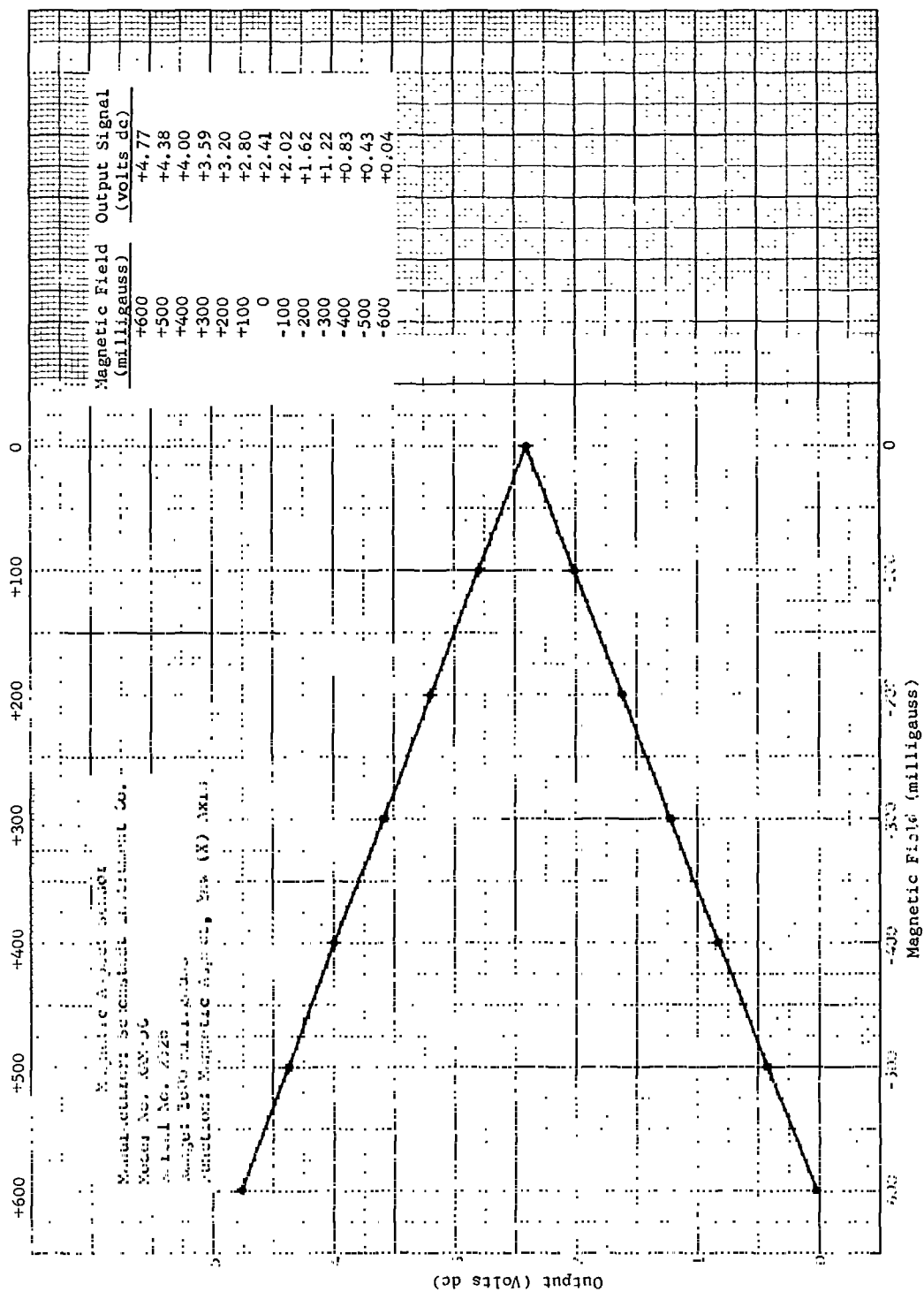


Figure 11. Magnetic Aspect Sensor, Calibration Test Curve for Yaw (X) Axis

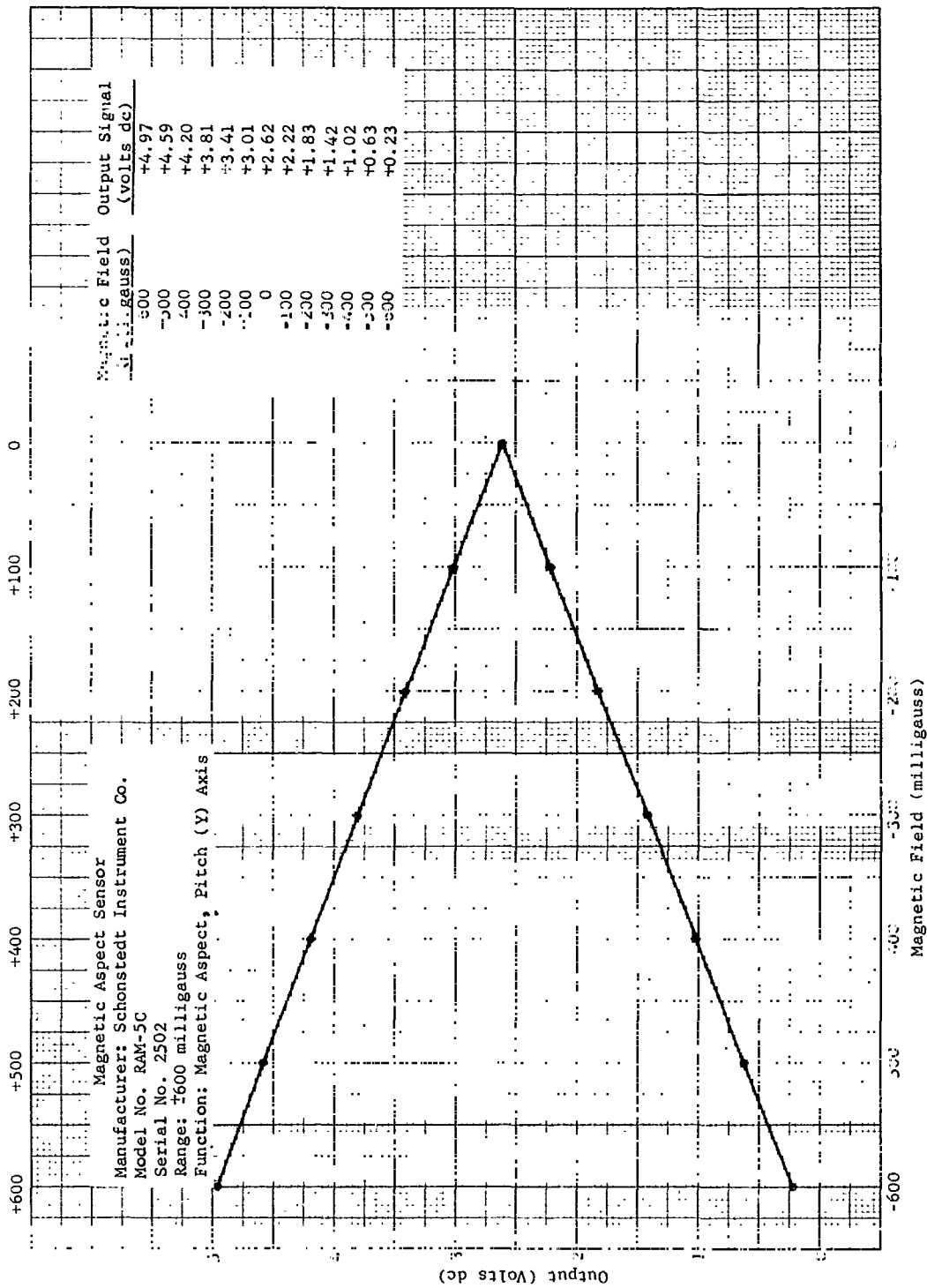


Figure 12. Magnetic Aspect Sensor, Calibration Test Curve for Pitch (Y) Axis

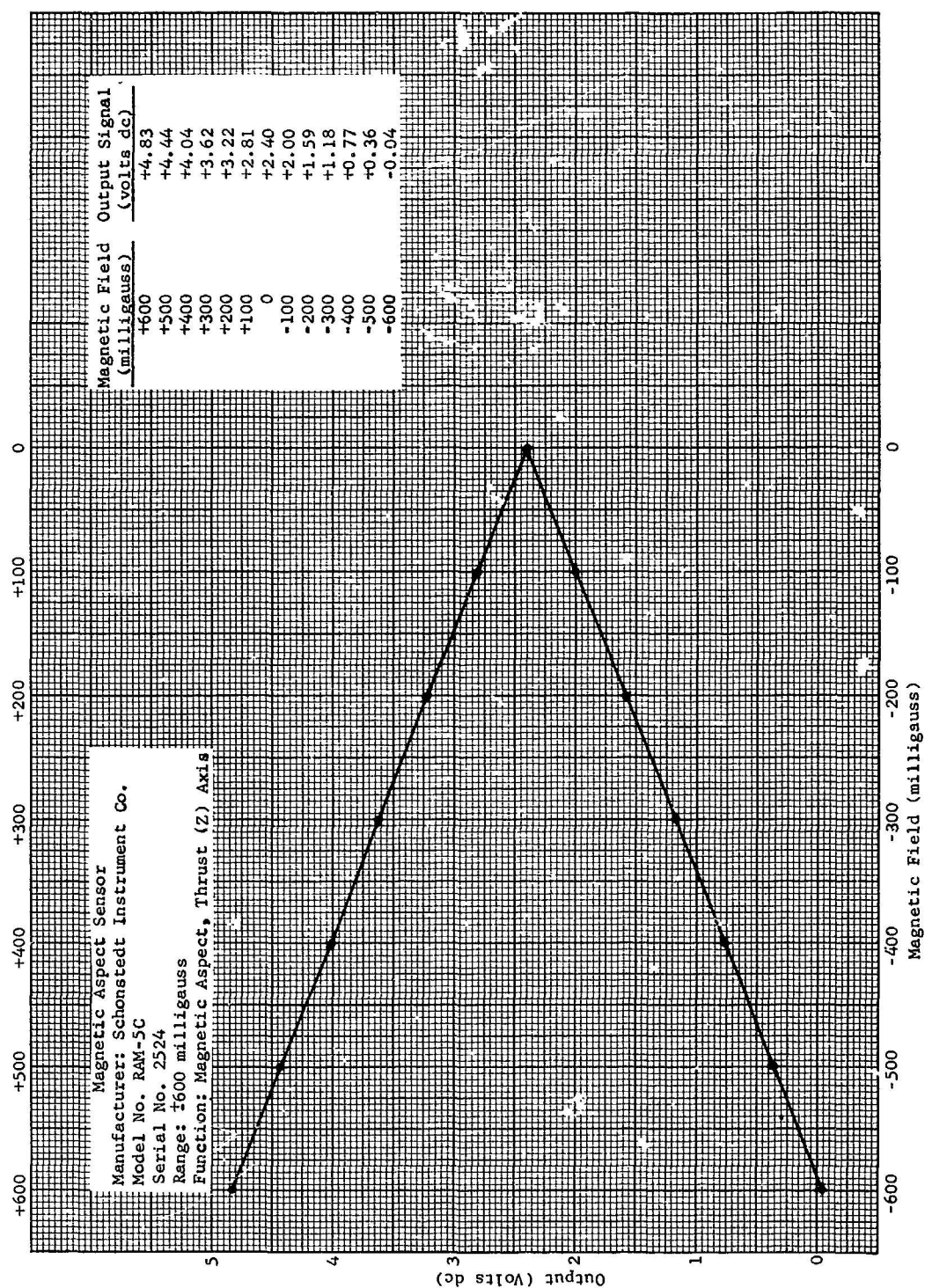


Figure 13. Magnetic Aspect Sensor, Calibration Test Curve for Thrust (Z) Axis

### SECTION III

#### VEHICLE ACCELERATION AND VIBRATION DATA

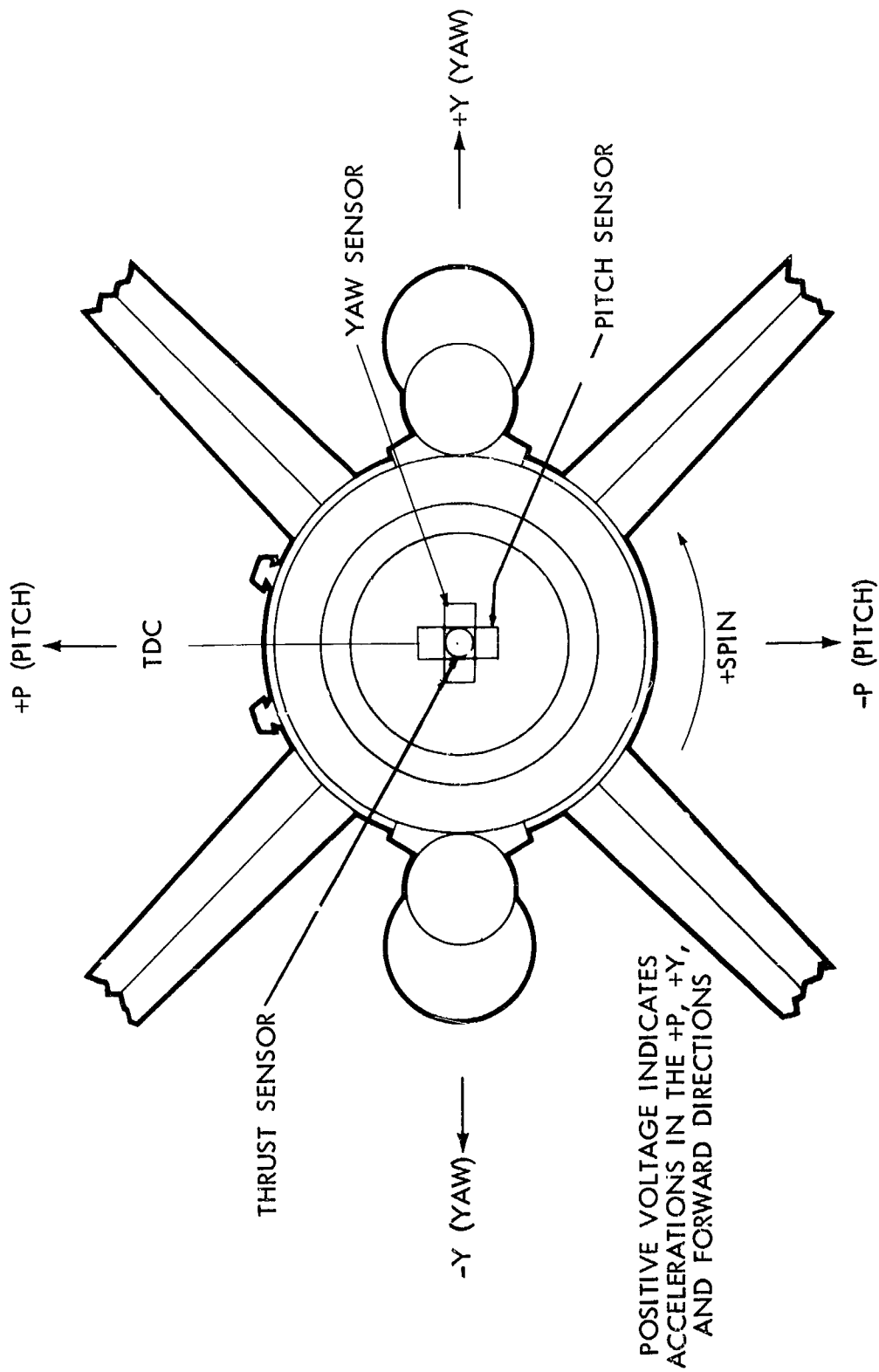


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TABLE 18  
ACCELEROMETERS AND VIBRATION SENSORS

Accelerometer	Manufacturer	Model No.	Serial No.	Full Scale Range
Sensor, Yaw Axis	Kistler	303T	1411	$\pm 7.5$ g
Sig. Cond. Unit	GSFC	N/A	1	
Sensor, Pitch Axis	Kistler	303T	1414	$\pm 7.5$ g
Sig. Cond. Unit	GSFC	N/A	2	
Sensor, Thrust Axis	Kistler	303T	1413	0 to 50 g
Sig. Cond. Unit	GSFC	N/A	3	

Vibration Accelerometer	Manufacturer	Model No.	Serial No.	Full Scale Range
Sensor, Yaw Axis	Endevco	2221E	PB64	$\pm 10$ g
Sig. Cond. Unit	Endevco	2640M27	RA74	
Sensor, Pitch Axis	Endevco	2221E	PB65	$\pm 10$ g
Sig. Cond. Unit	Endevco	2640M27	RA76	
Sensor, Thrust Axis	Endevco	2221E	PB62	$\pm 20$ g
Sig. Cond. Unit	Endevco	2642M85	RB05	



NOTE: THE THREE ACCELEROMETERS ARE MOUNTED ON THE TOP DECK.

Figure 14. Acceleration Sensors, Orientation in Flight 16.06 (looking aft)

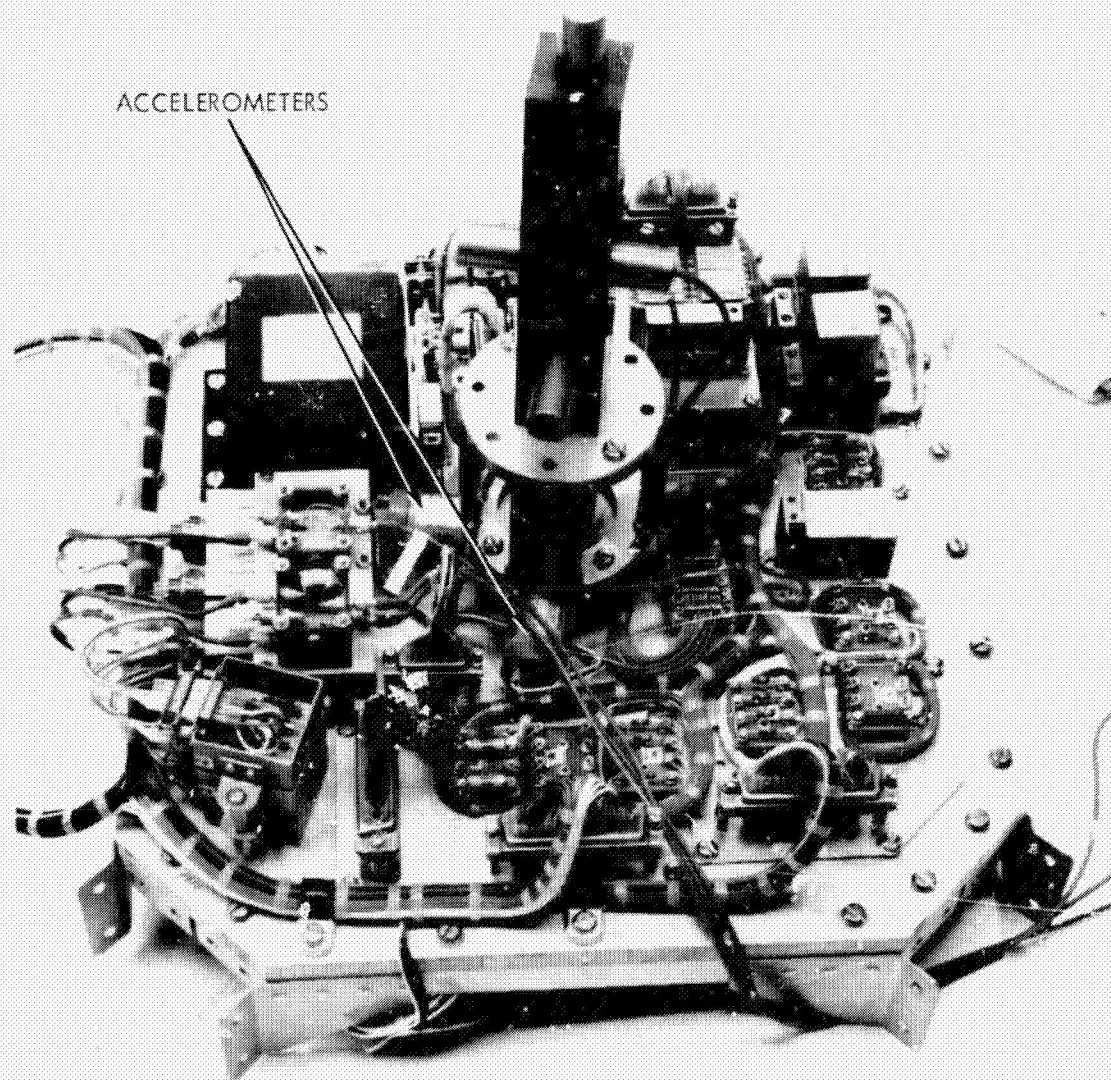


Figure 15. Accelerometer Installation, Pitch and Yaw Axes

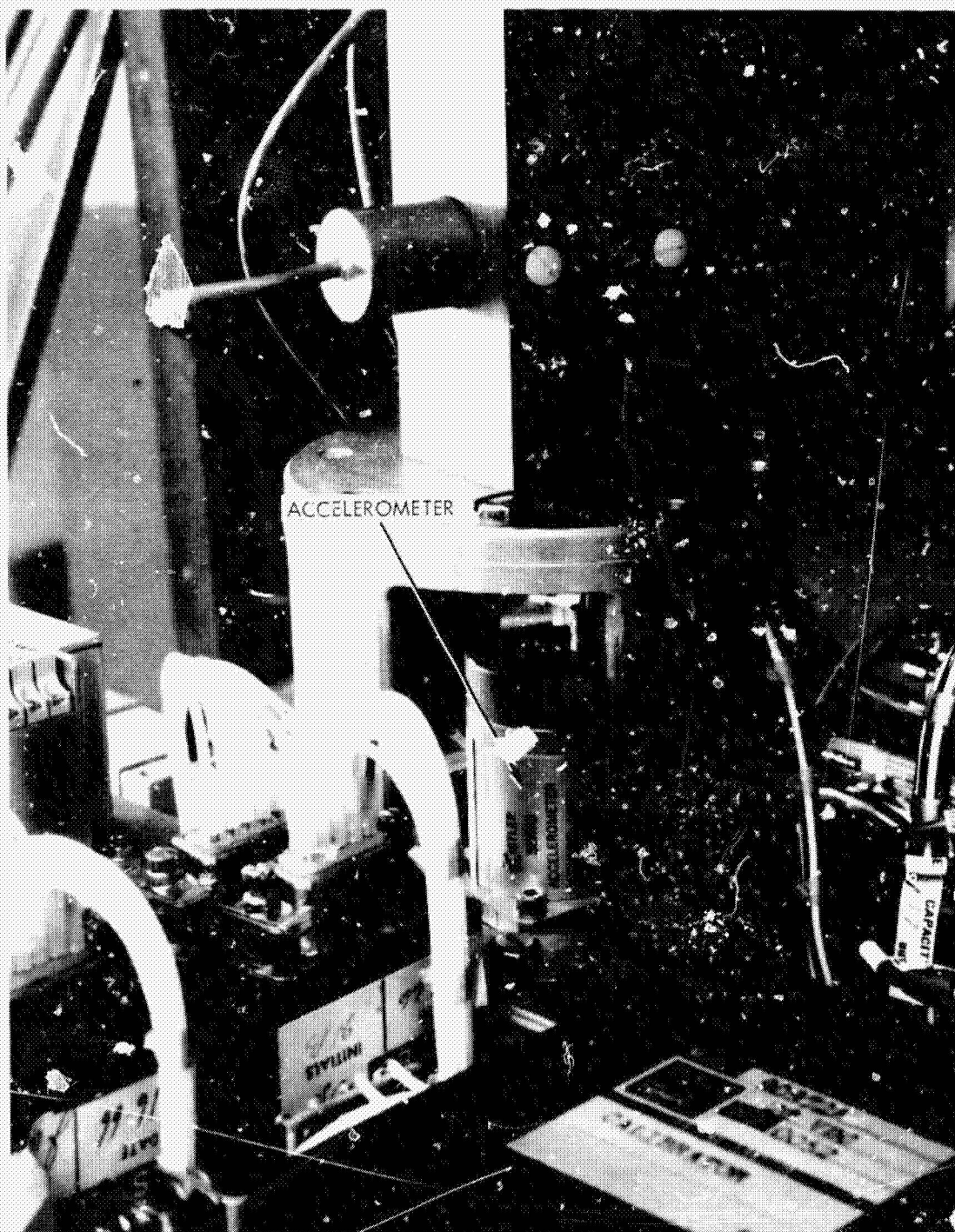


Figure 16. Accelerometer Installation, Thrust Axis

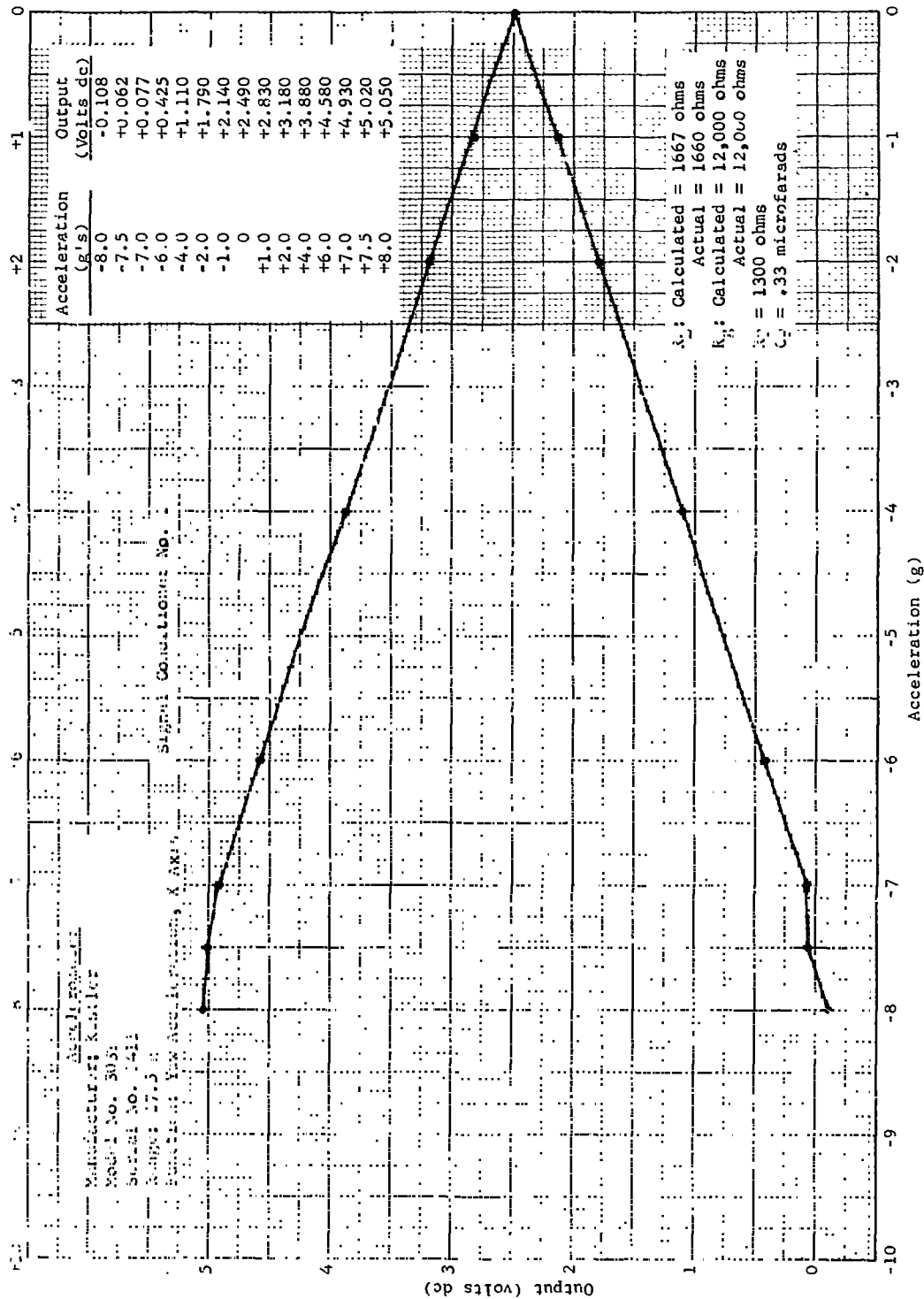


Figure 17. Accelerometer, Calibration Curve for Yaw (X) Axis

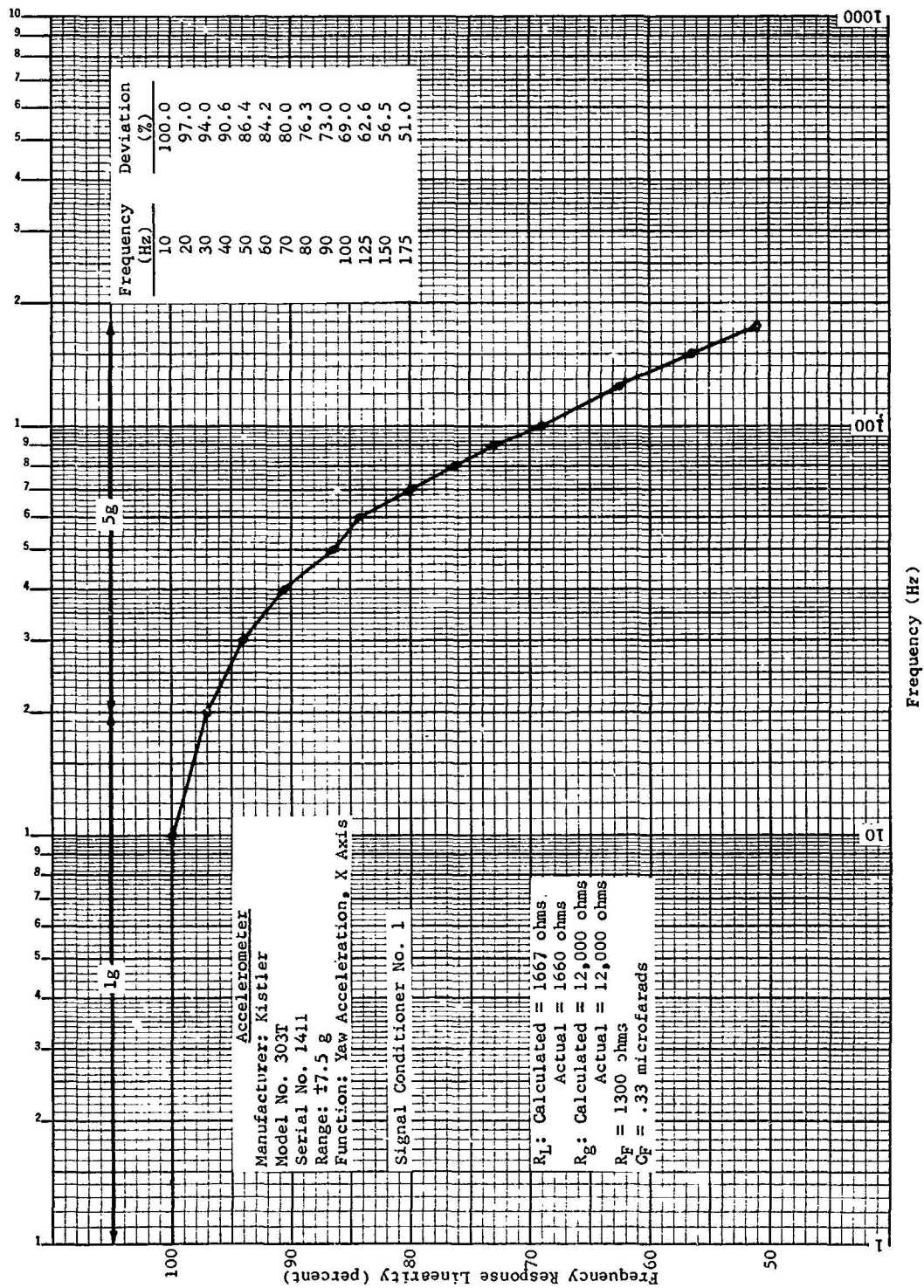


Figure 18. Accelerometer, Frequency Response Curve for Yaw (X) Axis

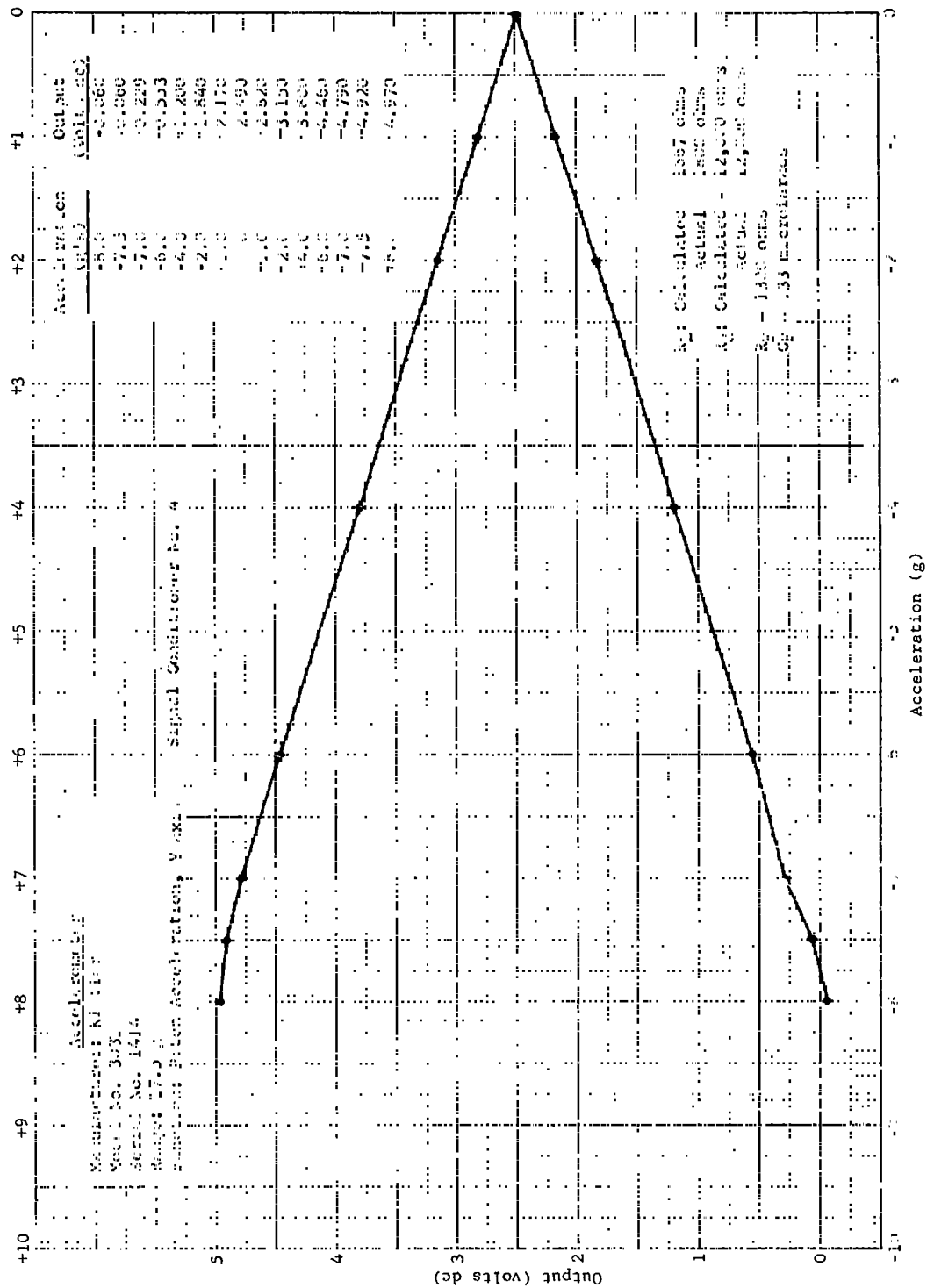


Figure 19. Accelerometer, Calibration Curve for Pitch (Y) Axis

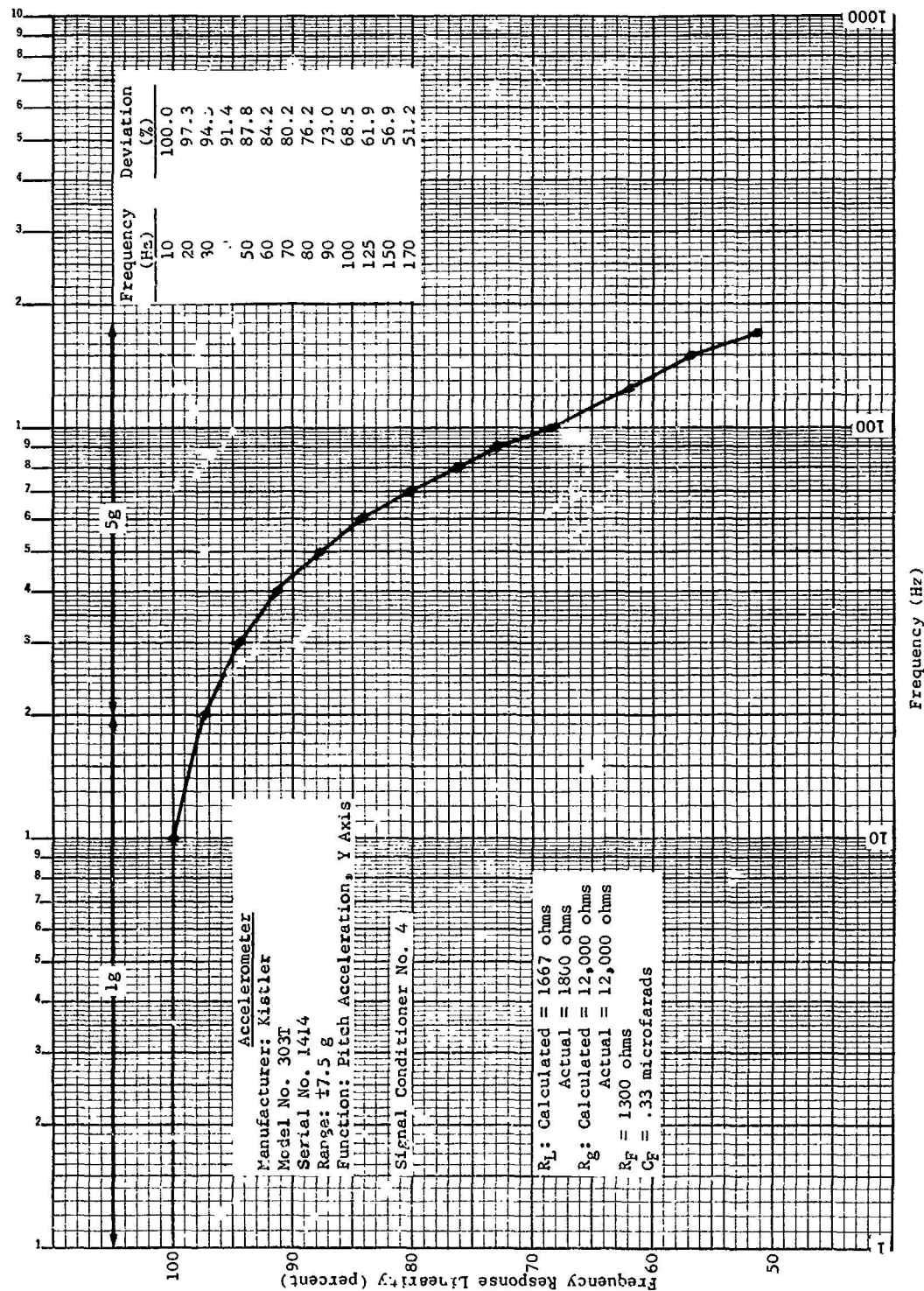


Figure 20. Accelerometer, Frequency Response Curve for Pitch (Y) Axis

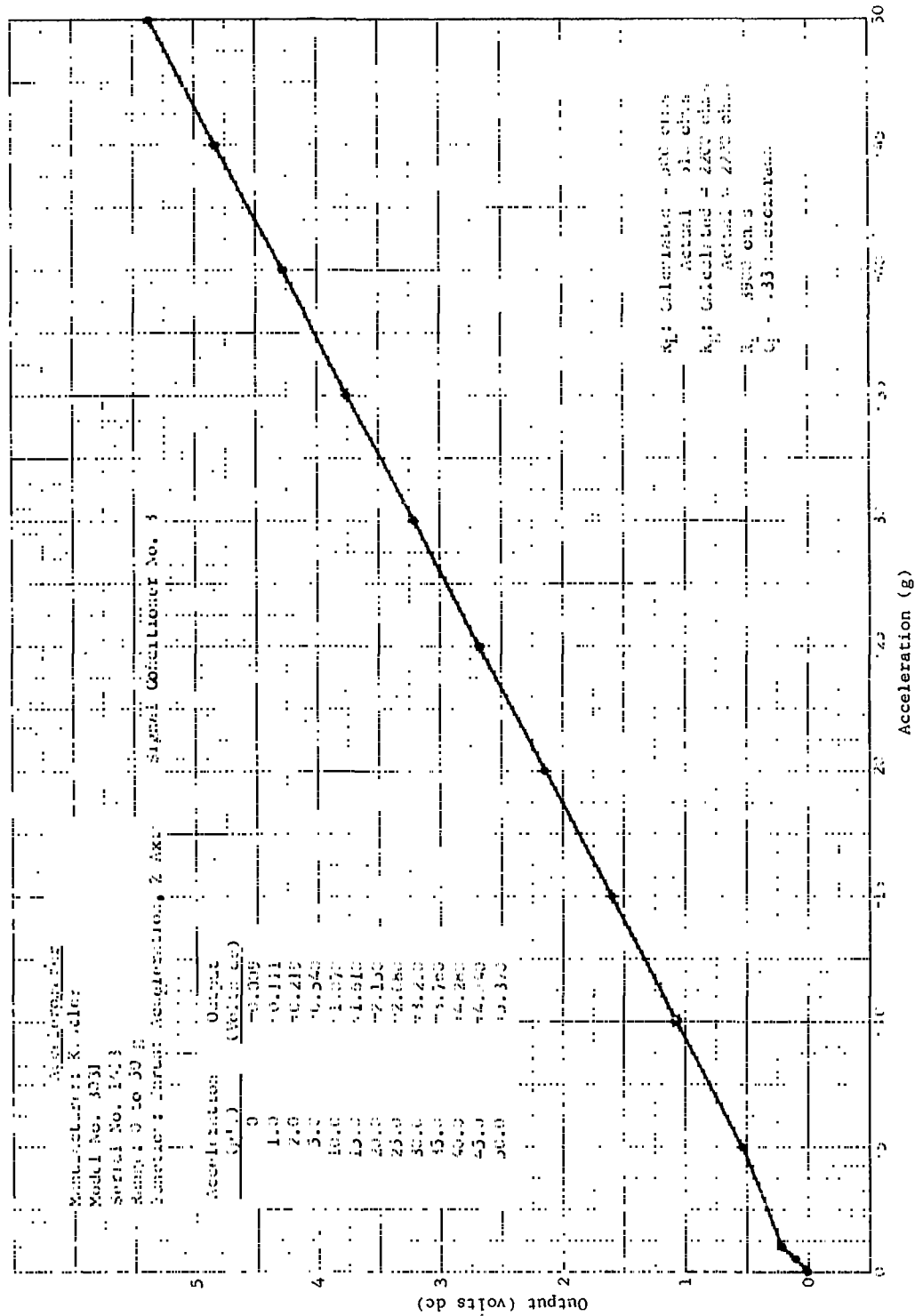


Figure 21. Accelerometer, Calibration Curve for Thrust (Z) Axis

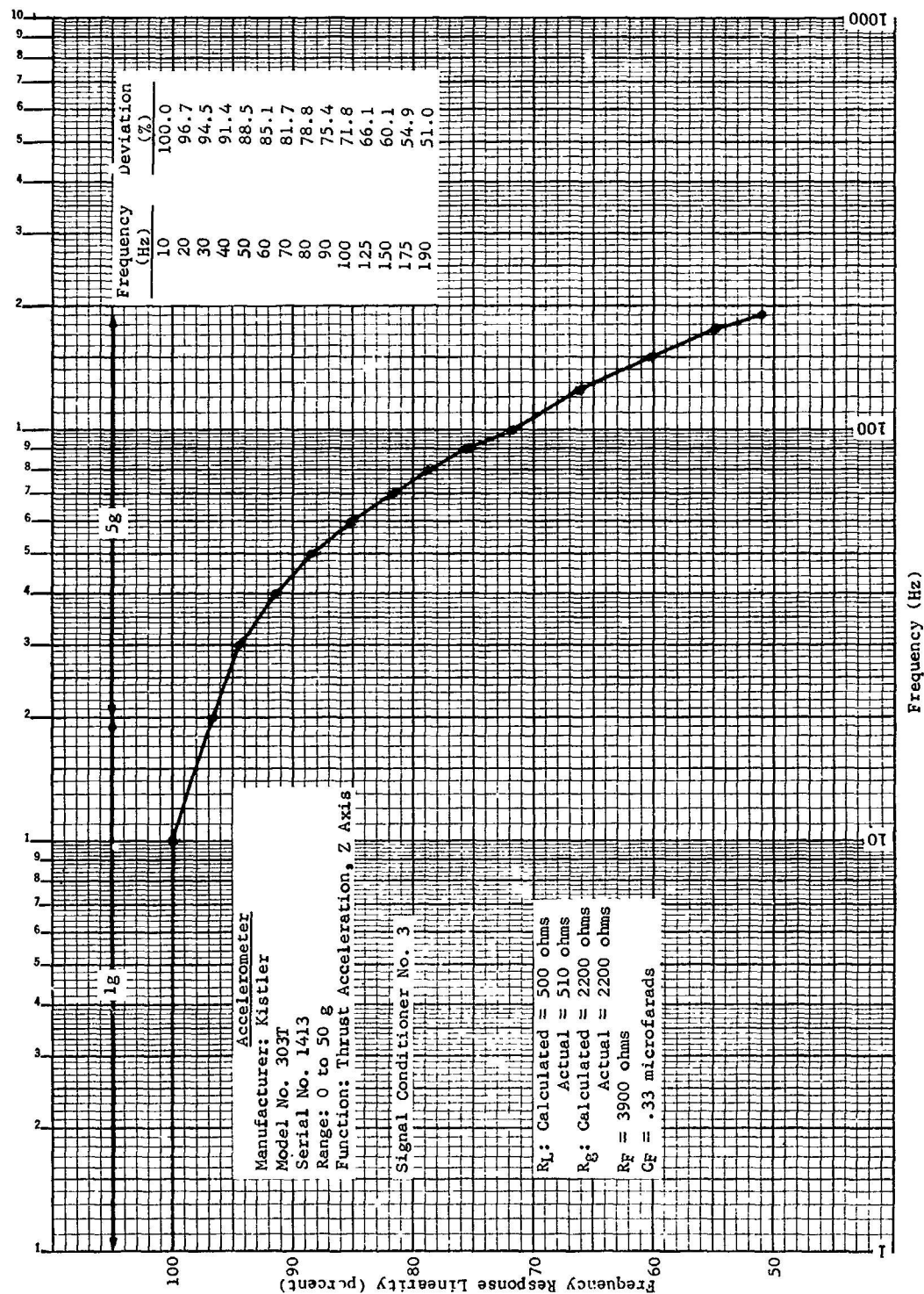
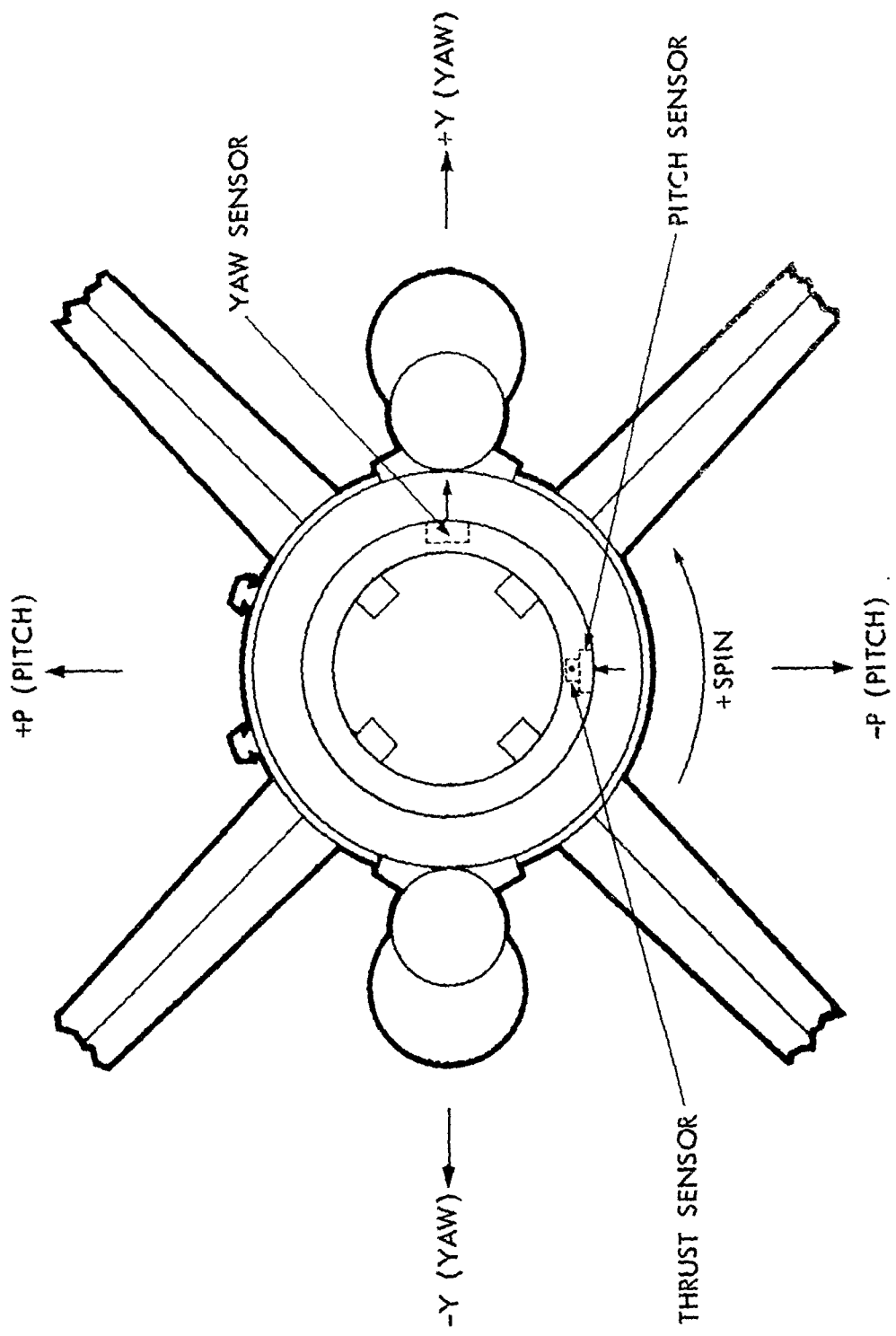


Figure 22. Accelerometer, Frequency Response Curve for Thrust (Z) Axis



NOTE: TRANSDUCERS ARE MOUNTED AT BASE OF PAYLOAD SUPPORT RING.

Figure 23. Vibration Accelerometers, Orientation in Flight 16.06 GR (looking aft)

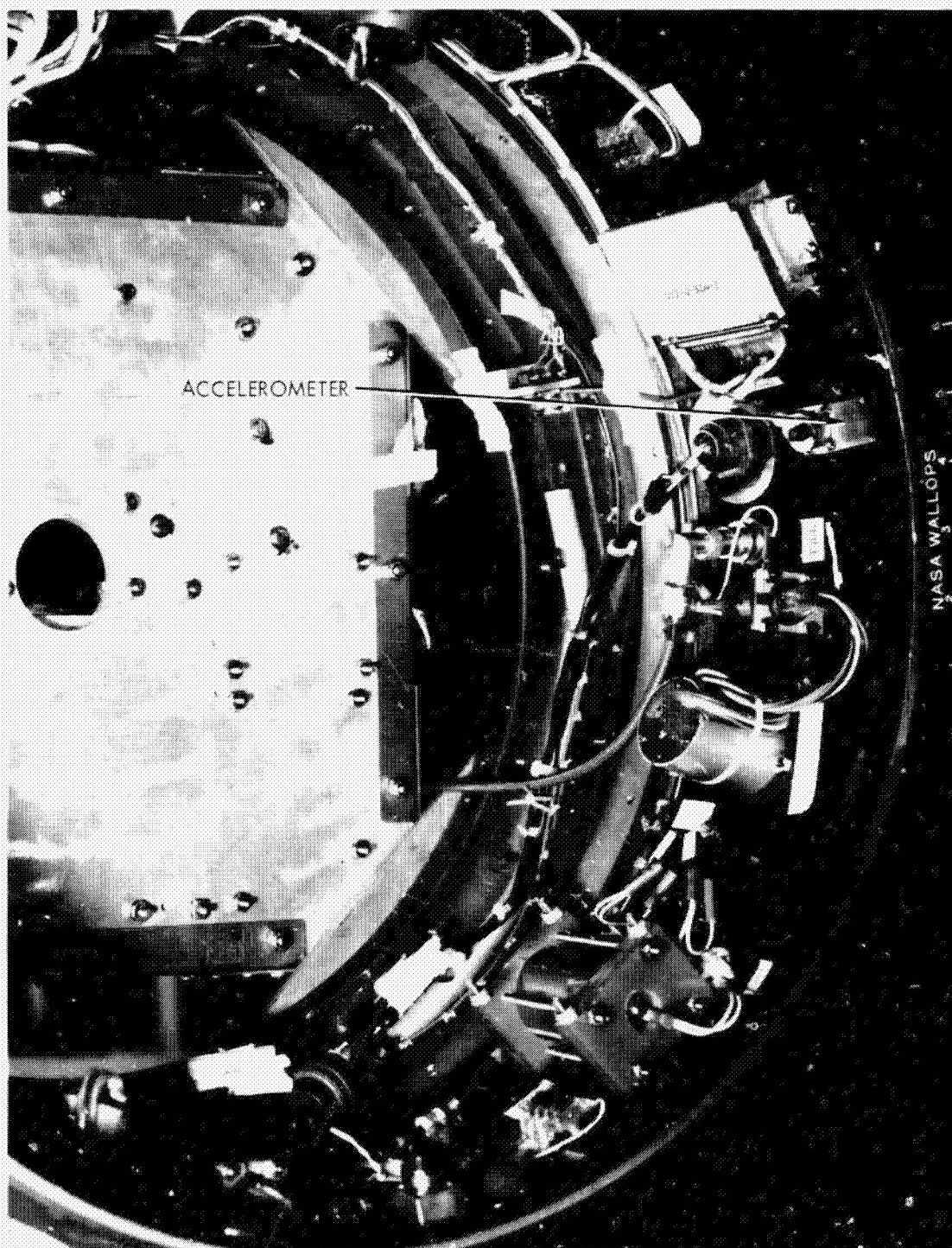


Figure 24. Vibration Accelerometer Installation, Yaw Axis

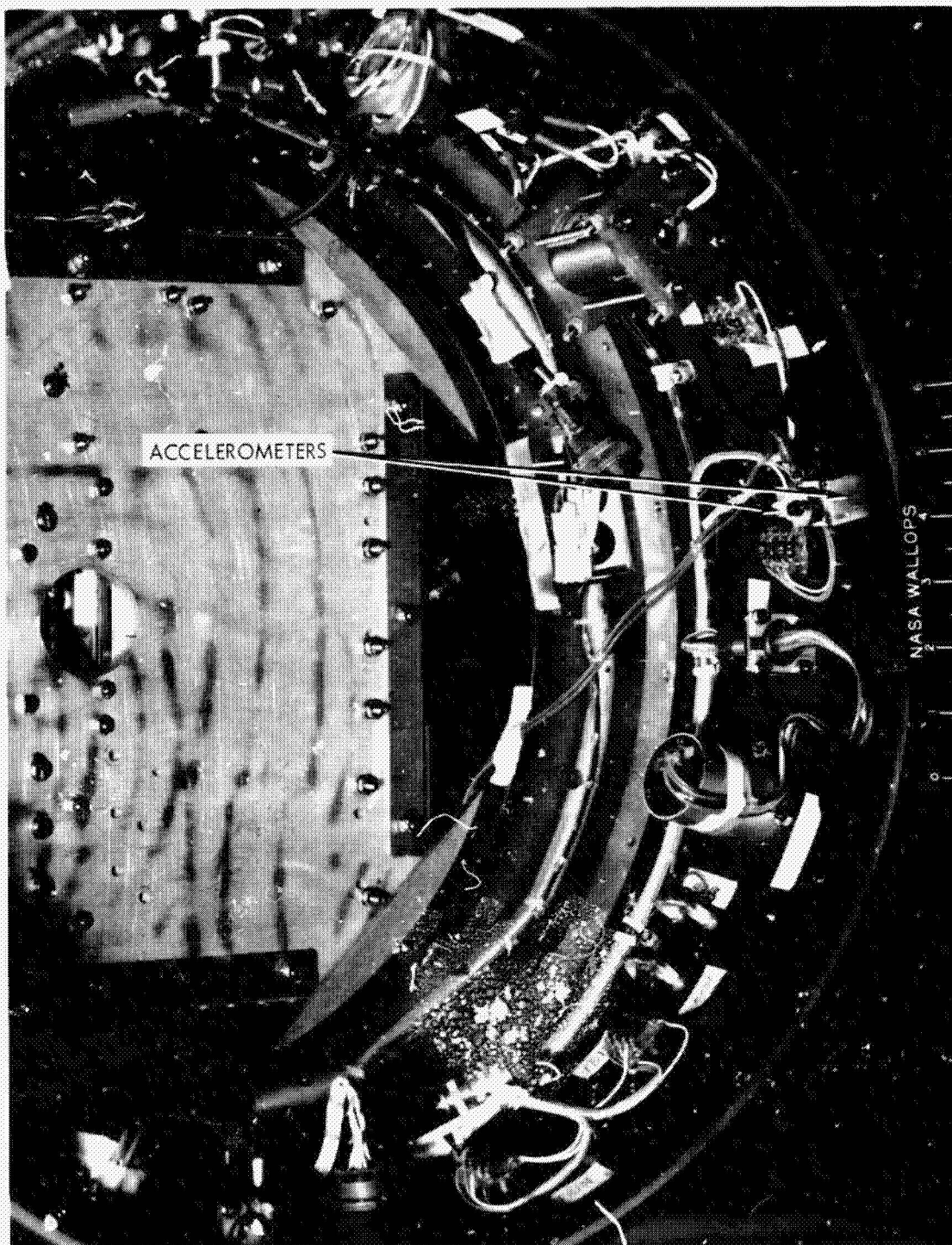


Figure 25. Vibration Accelerometer Installation, Pitch and Thrust Axes



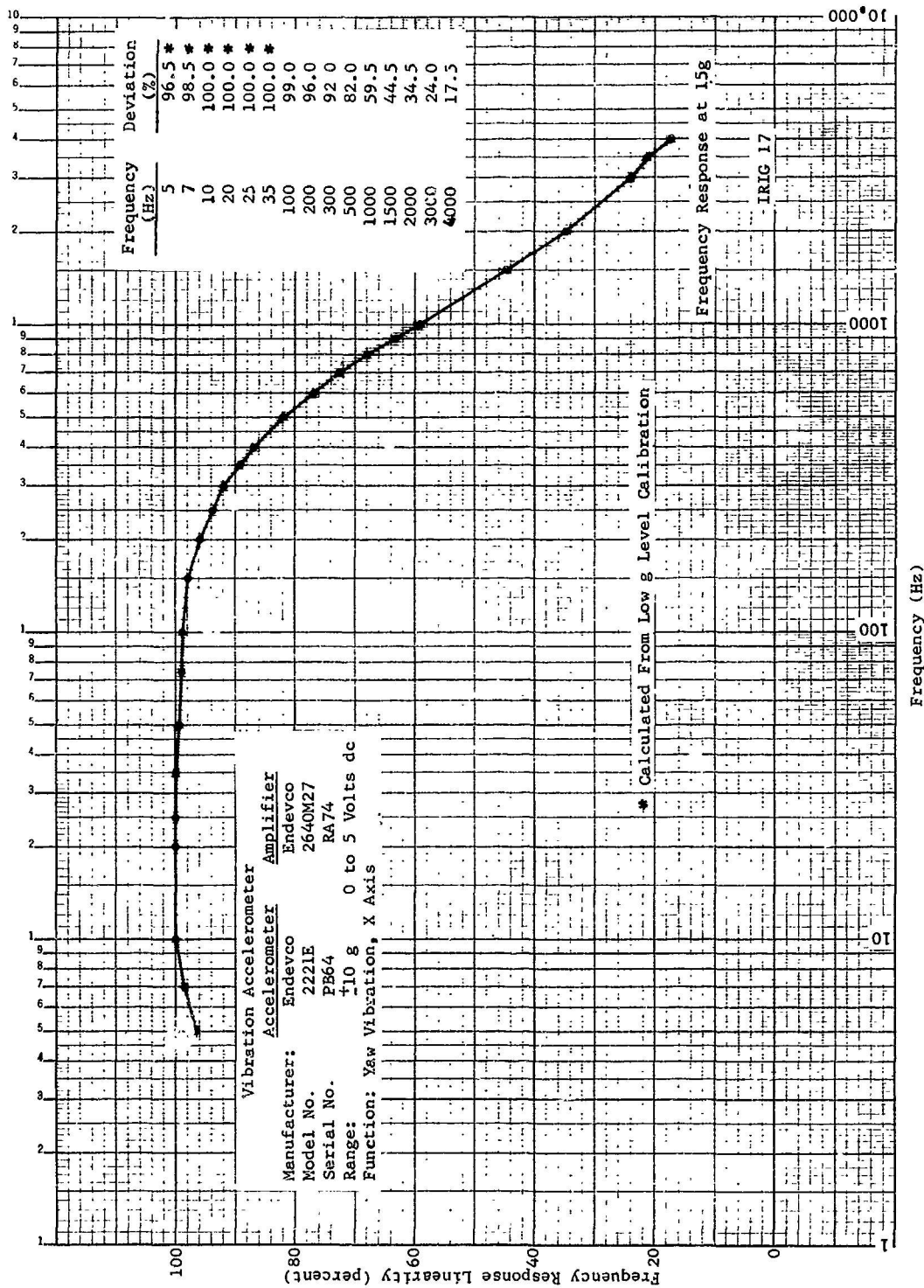


Figure 27. Vibration Accelerometer, Frequency Response Curve for Yaw (X) Axis

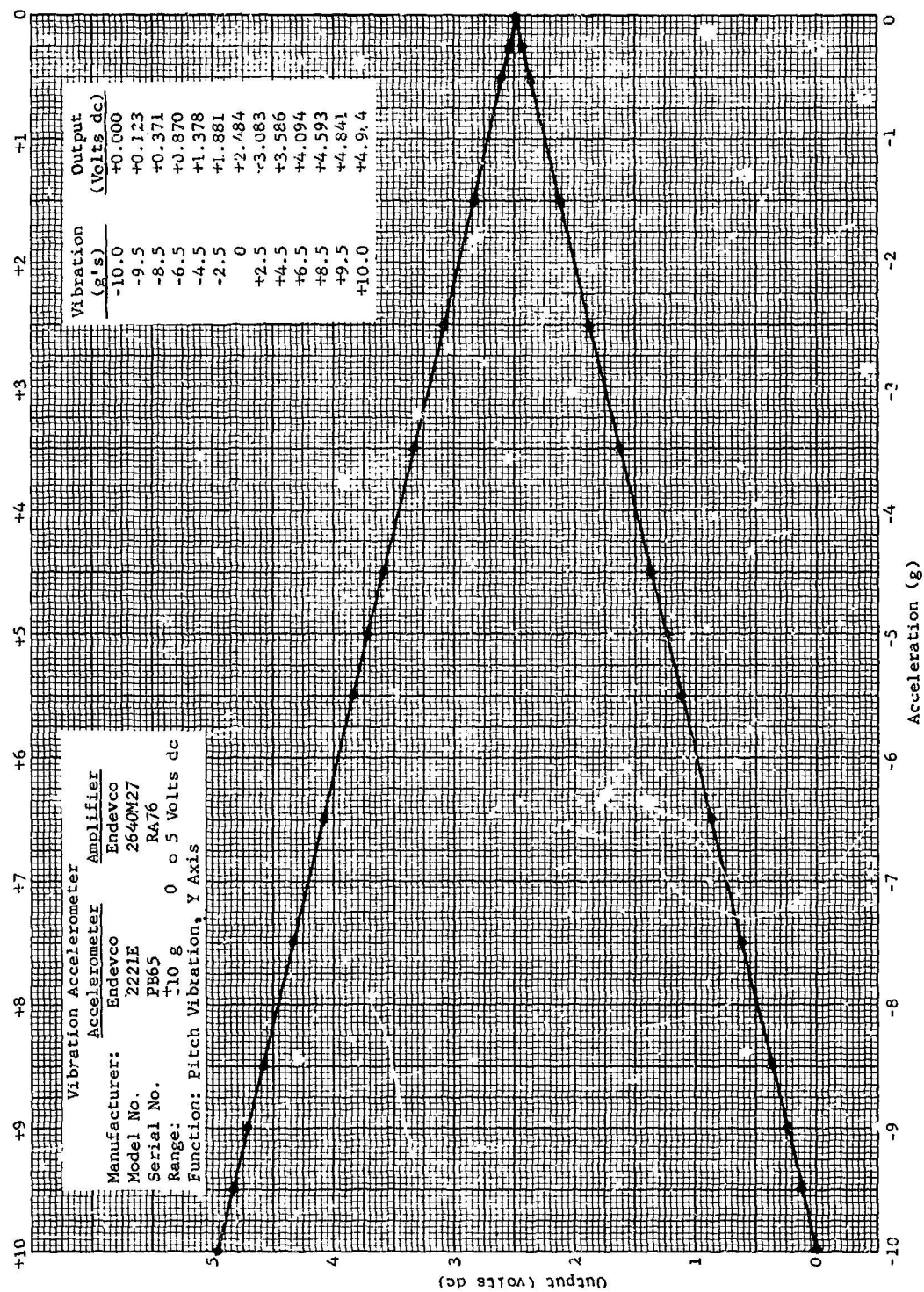


Figure 28. Vibration Accelerometer, Calibration Curve for Pitch (Y) Axis

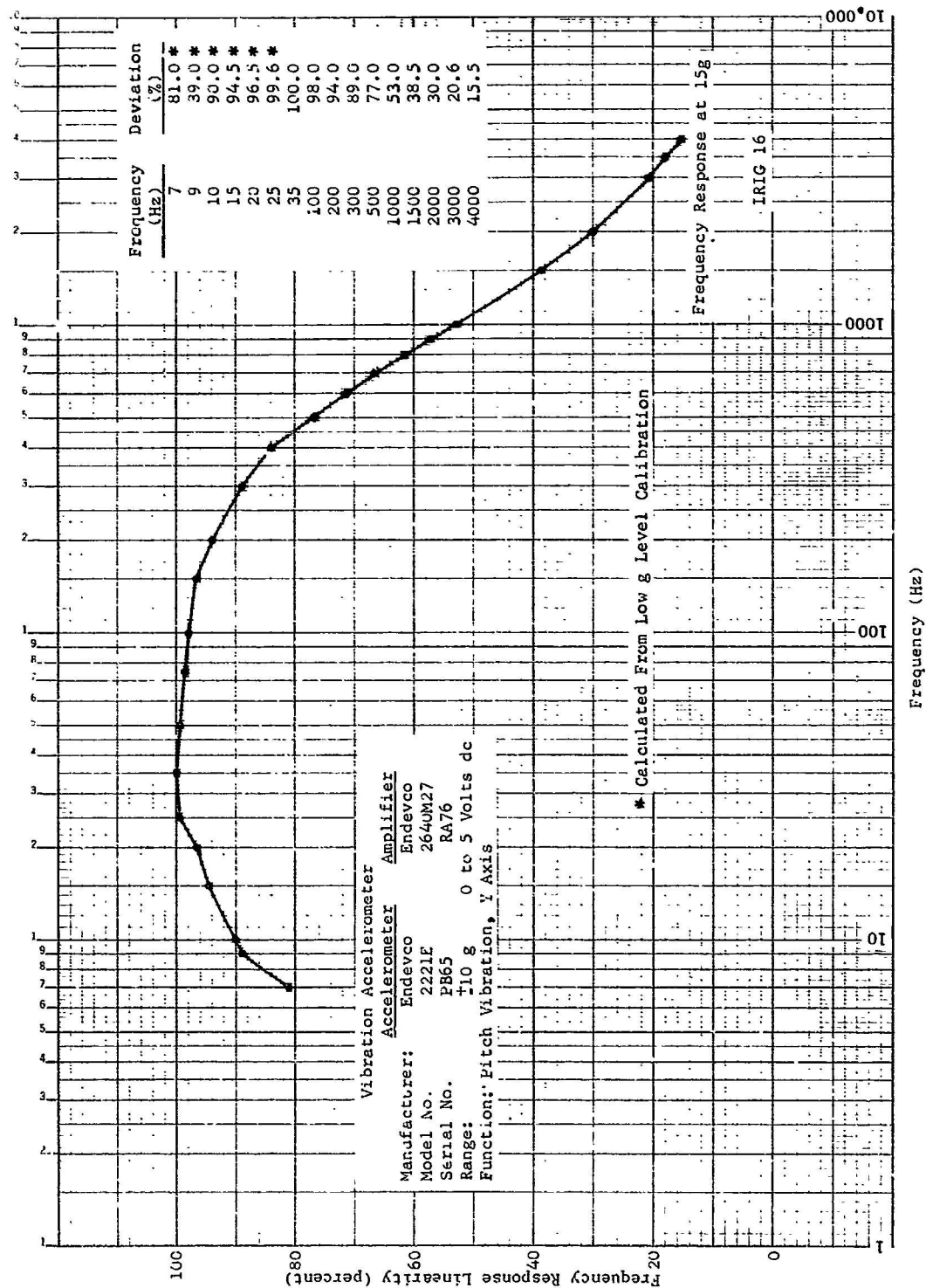


Figure 29. Vibration Accelerometer, Frequency Response Curve for Pitch (Y) Axis

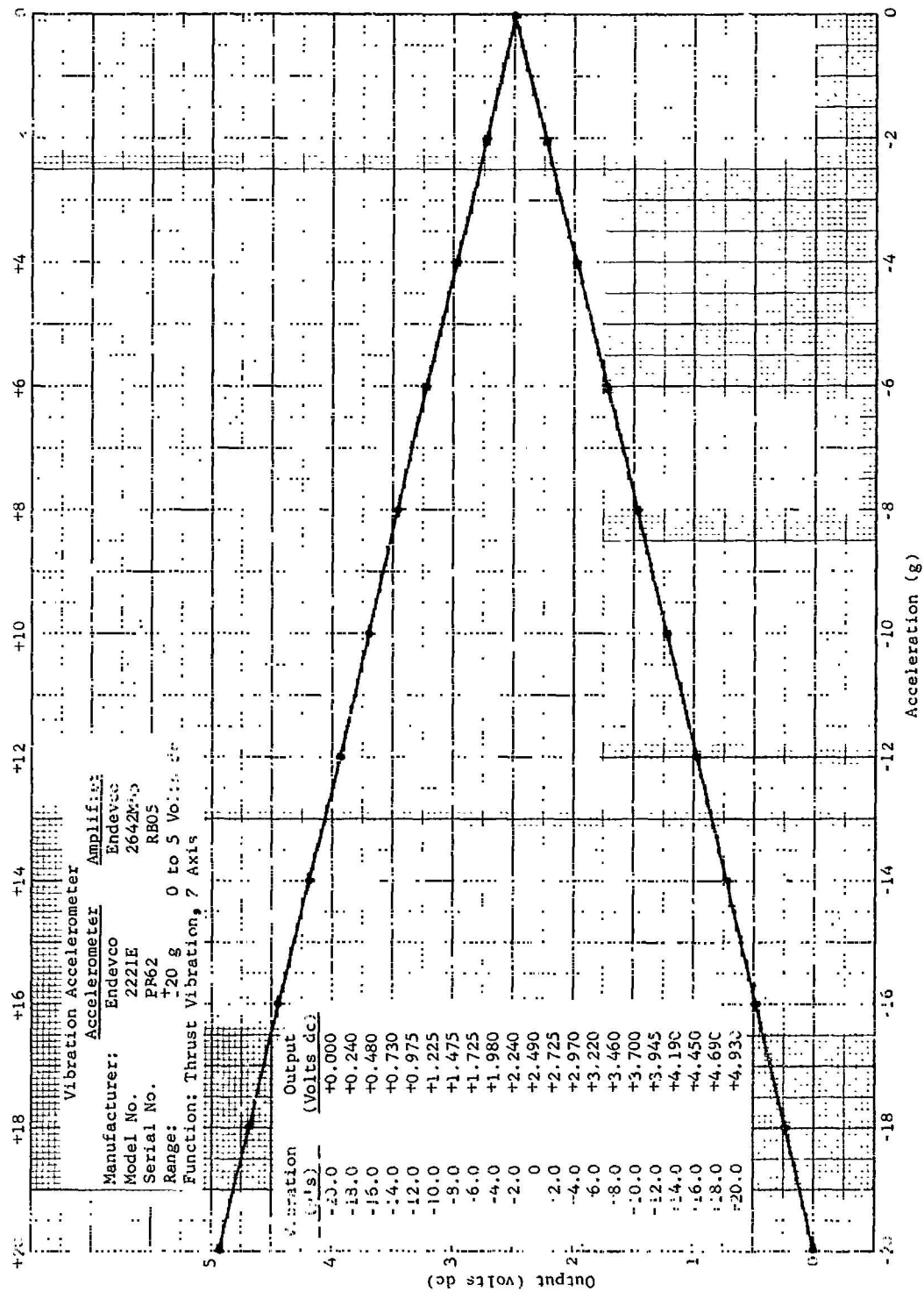


Figure 30. Vibration Accelerometer, Calibration Curve for Thrust (Z) Axis

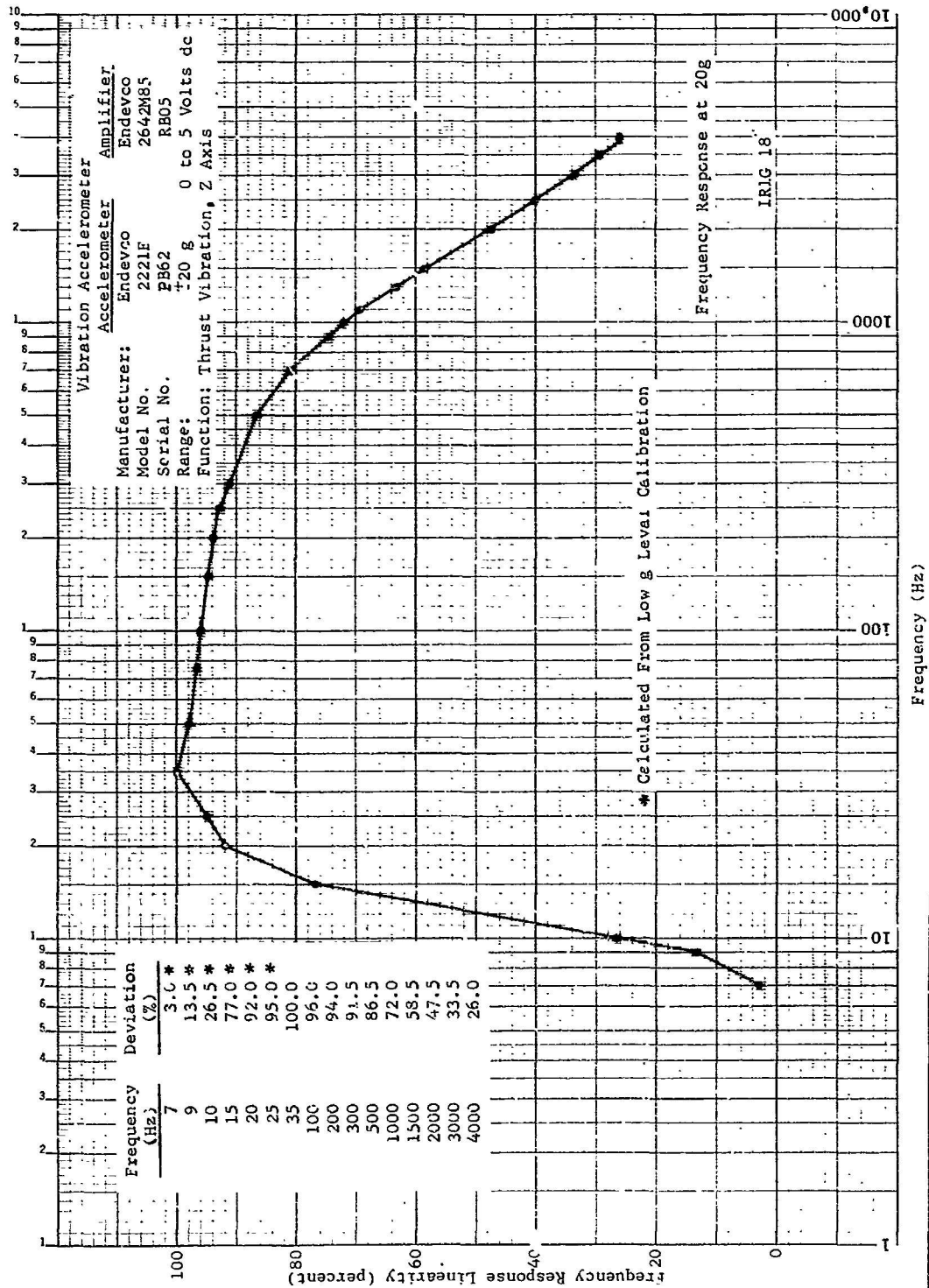


Figure 31. Vibration Accelerometer, Frequency Response Curve for Thrust (Z) Axis



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SECTION IV  
VEHICLE PRESSURE DATA



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TABLE 19  
PRESSURE SENSORS

Pressure Transducer	Manufacturer	Model No.	Serial No.	Range (psia)
PcI	CEC	4-326-0001	11481	0 to 600
Sig. Cond. Unit	BLH	950-0003	049	
PcII	CEC	4-326-0001	12575	0 to 600
Sig. Cond. Unit	BLH	950-0003	016	

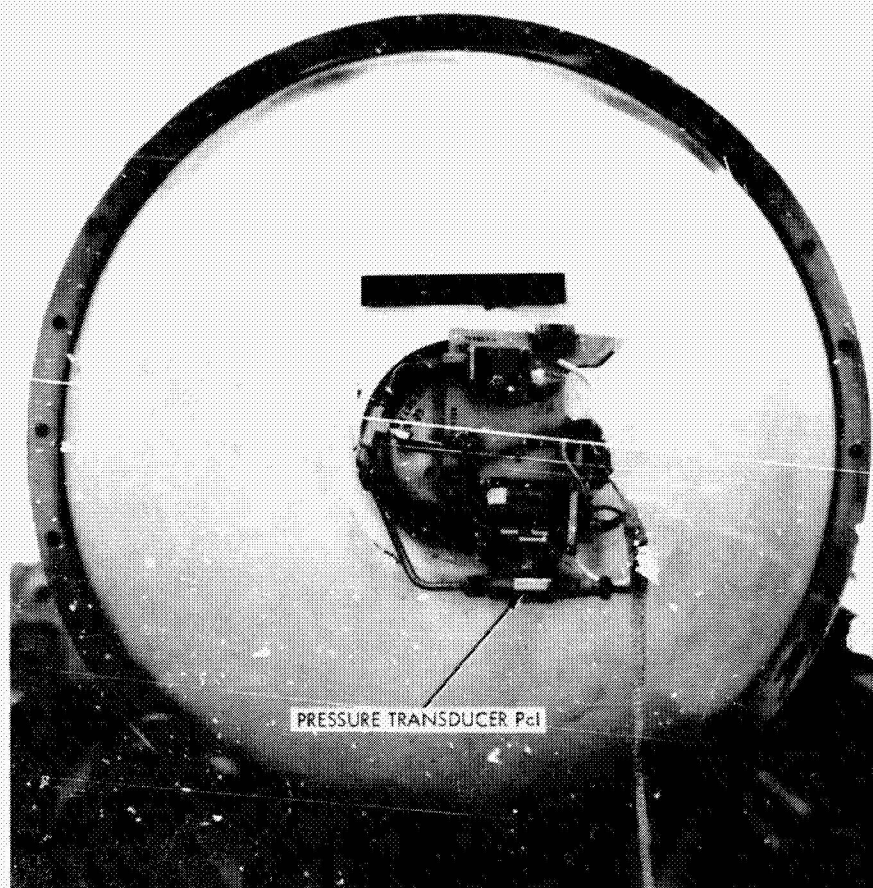


Figure 32. Pressure Transducer Installation (PcI)

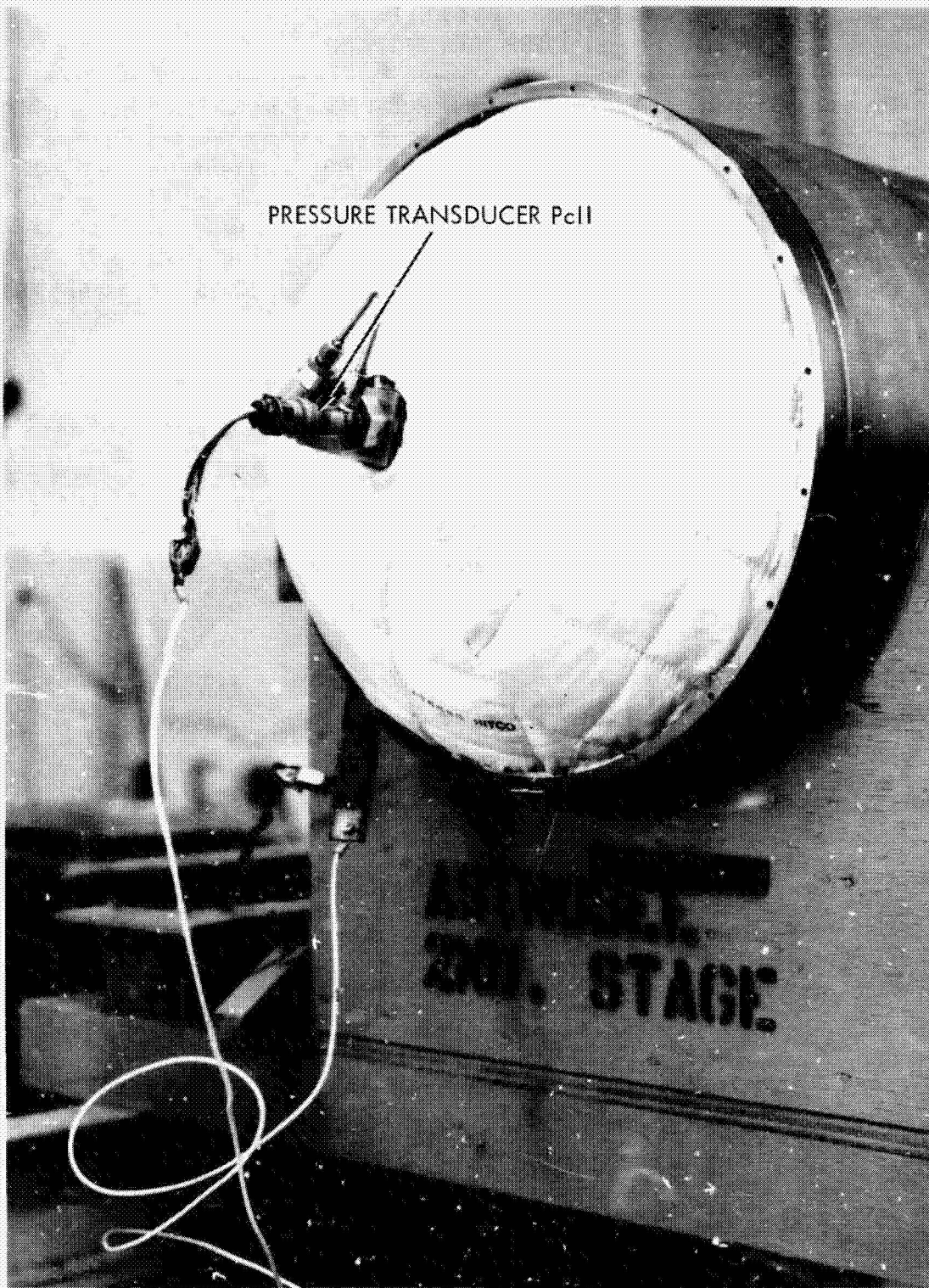


Figure 33. Pressure Transducer Installation (PcII)

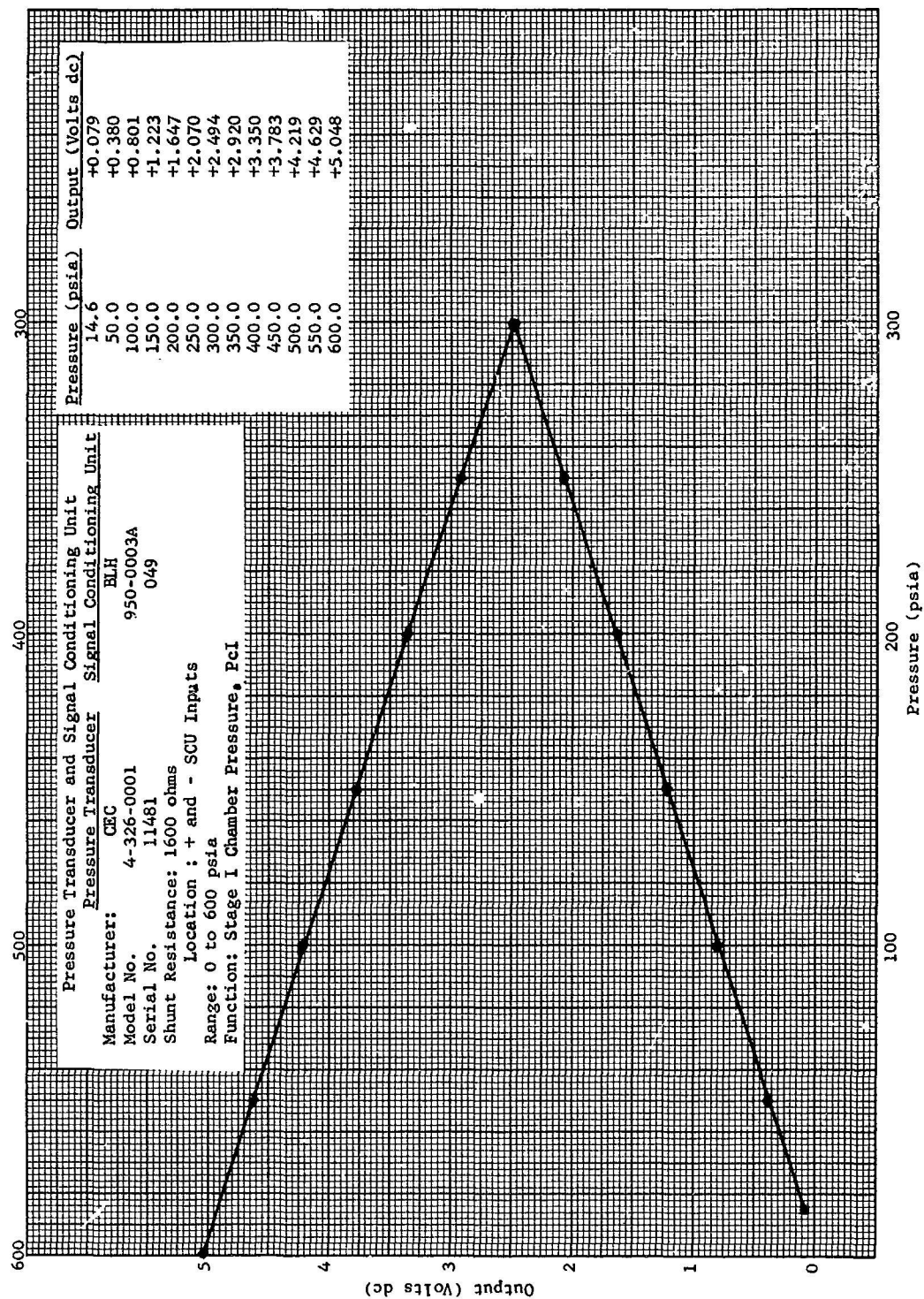


Figure 34. Stage I Pressure Transducer, Calibration Curve (Pcl)

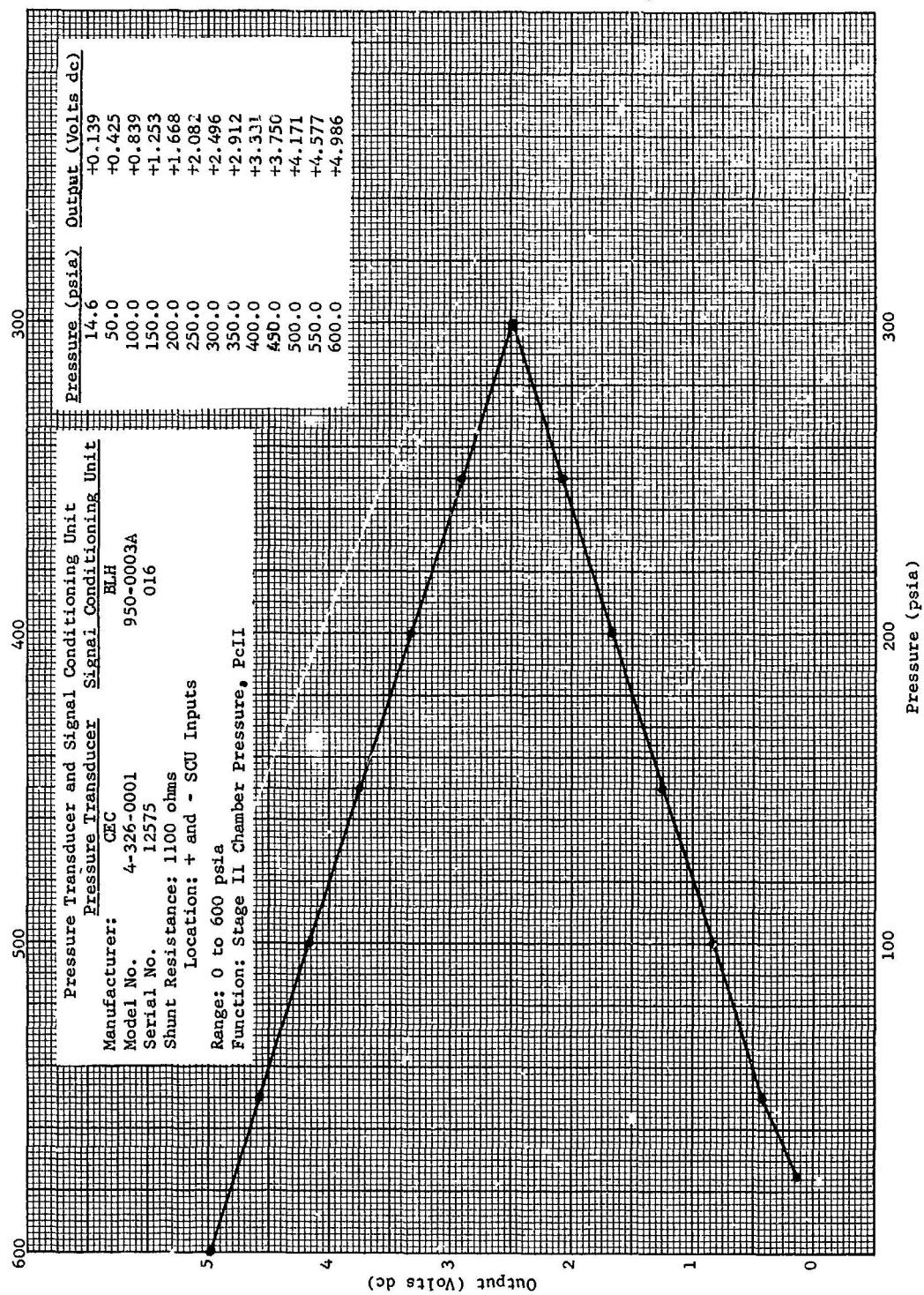


Figure 35. Stage II Pressure Transducer, Calibration Curve (PcII)

SECTION V  
ANTENNA DATA



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TABLE 20  
VSWR TEST MEASUREMENTS

Telemetry System	Frequency	VSWR
1	231.4 MHz	1.43
2	256.2 MHz	1.38

NOTE: DRAWING IS NOT TO SCALE

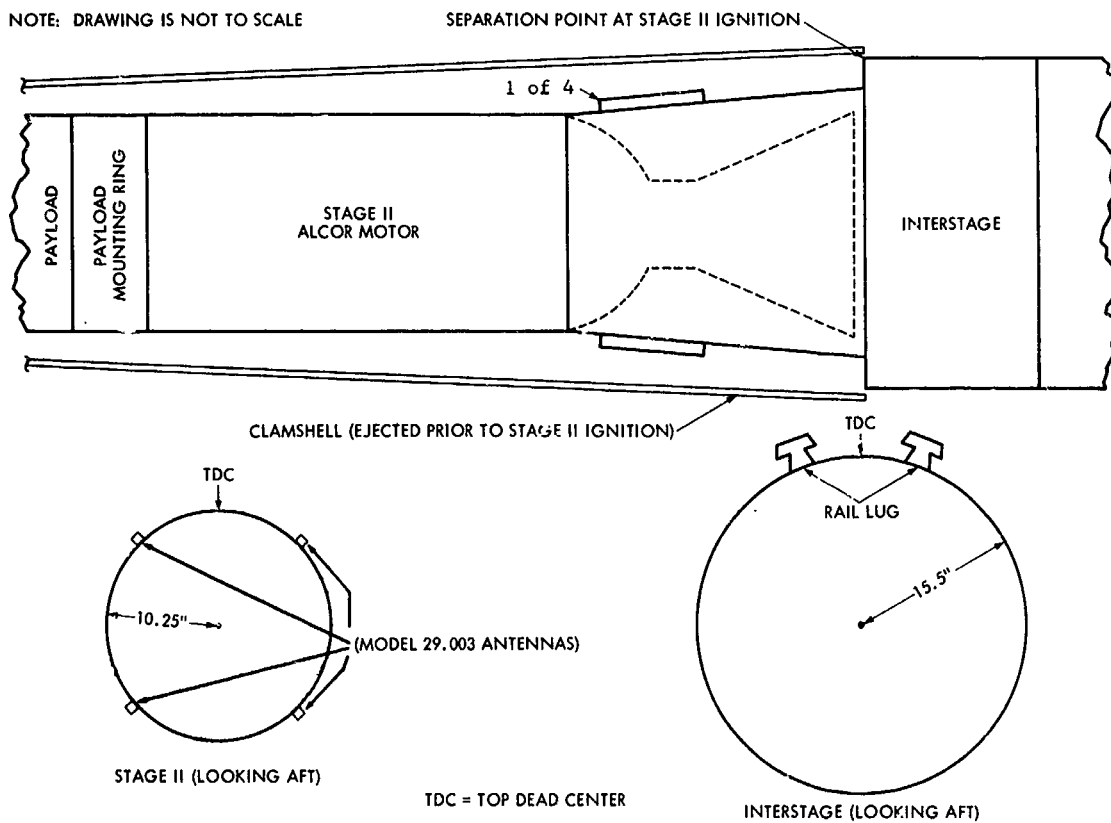


Figure 36. Telemetry Antennas, Orientation Diagram for Flight 16.06 GR

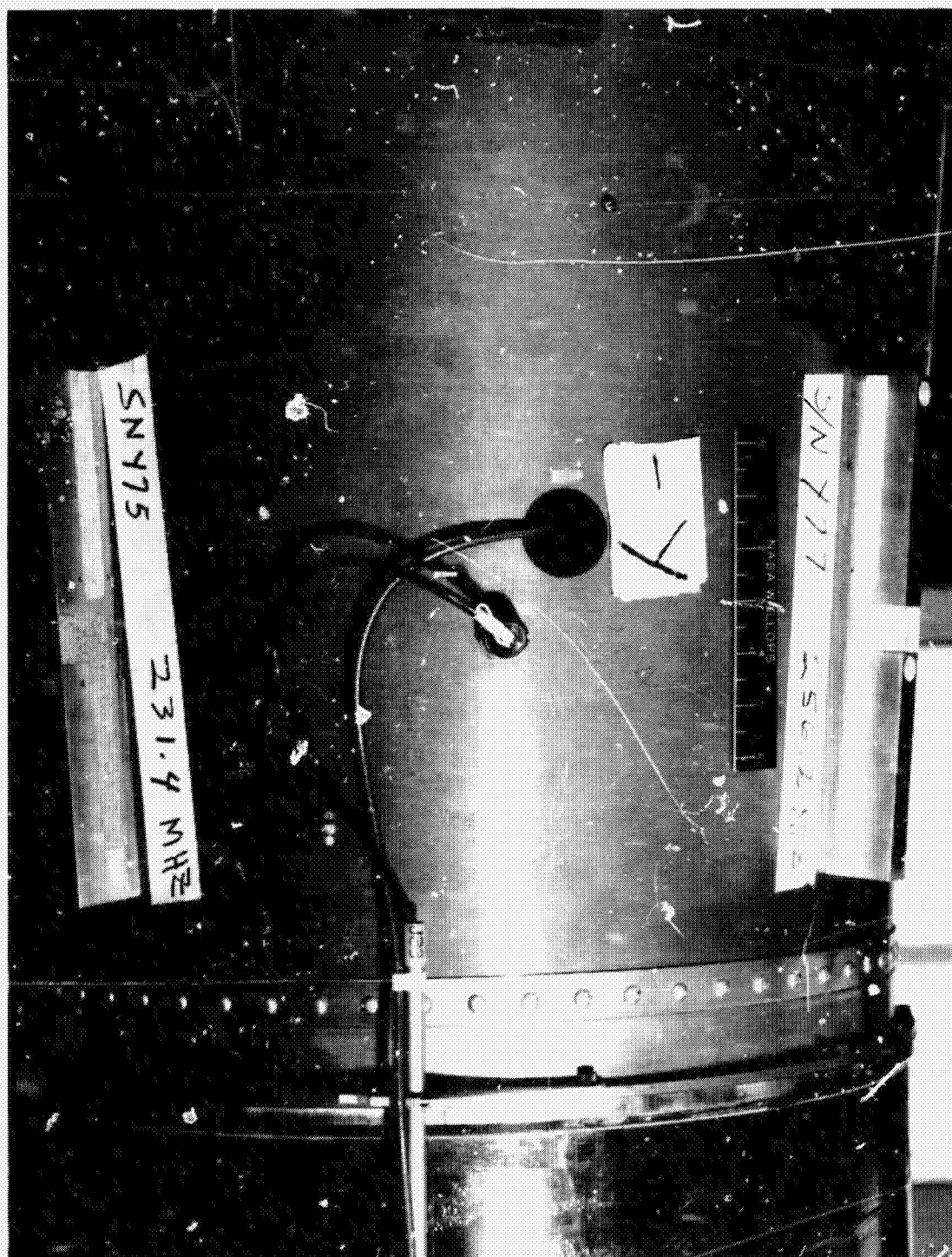


Figure 37. Telemetry Antennas, Installation (SN Y75, and SN Y77)



Figure 38. Telemetry Antennas, Installation (SN Y74, and SN Y76)

DATE 2-10-1969

Model No. 29.003  
Serial No's. Y74, Y75

Note: Parallel tuned  
curve at TEE

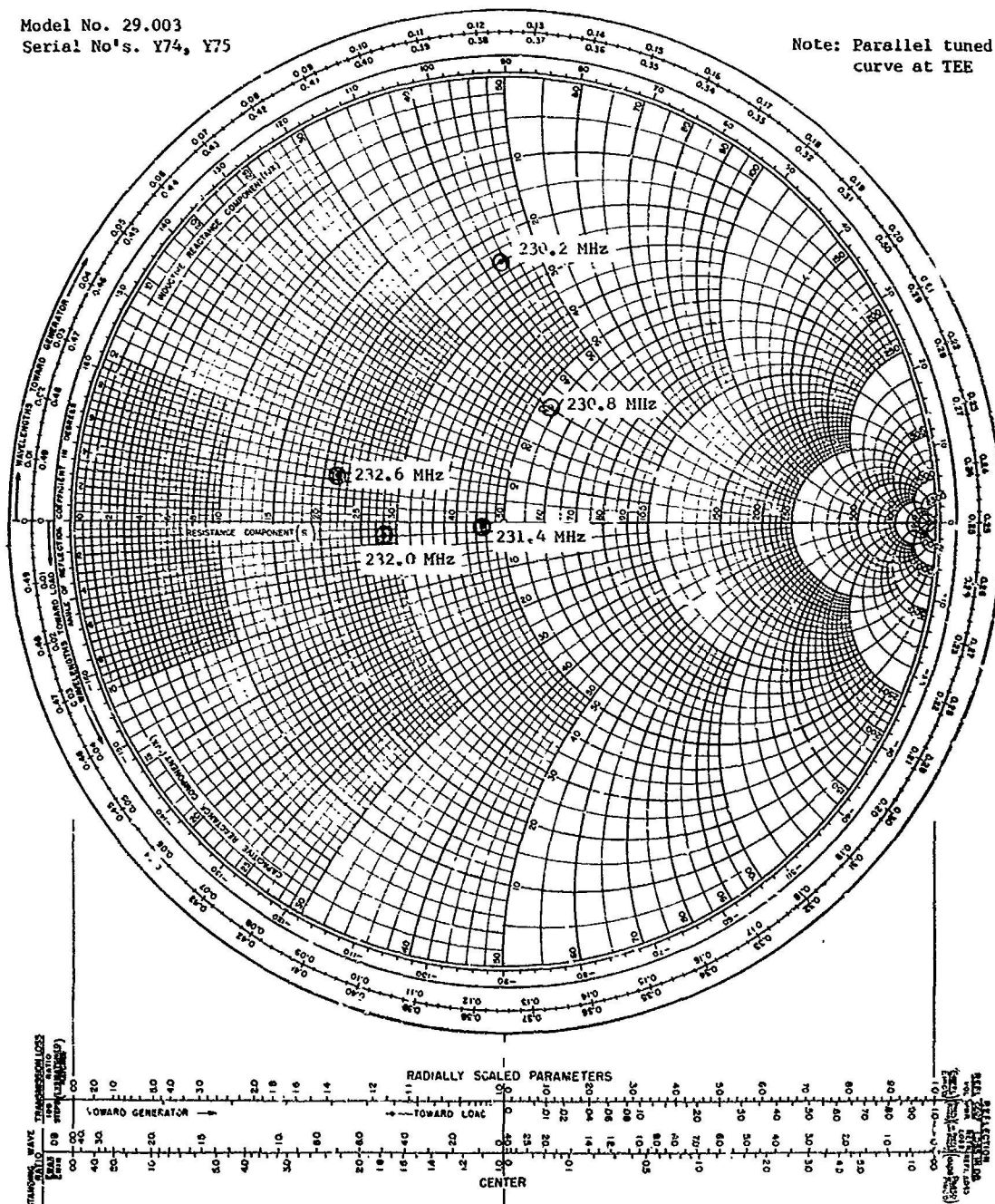


Figure 39. Telemetry No. 1, Antennas Impedance Plot (231.4 MHz)

TITLE Astrobres 16.06 Antennas, TM 2 (256.2 MHz)

DATE 2-10-1969

IMPEDANCE COORDINATES—50-OHM CHARACTERISTIC IMPEDANCE

Model No. 29.003  
Serial No's. Y/6, Y77

Note: Parallel tuned  
curve at TEE

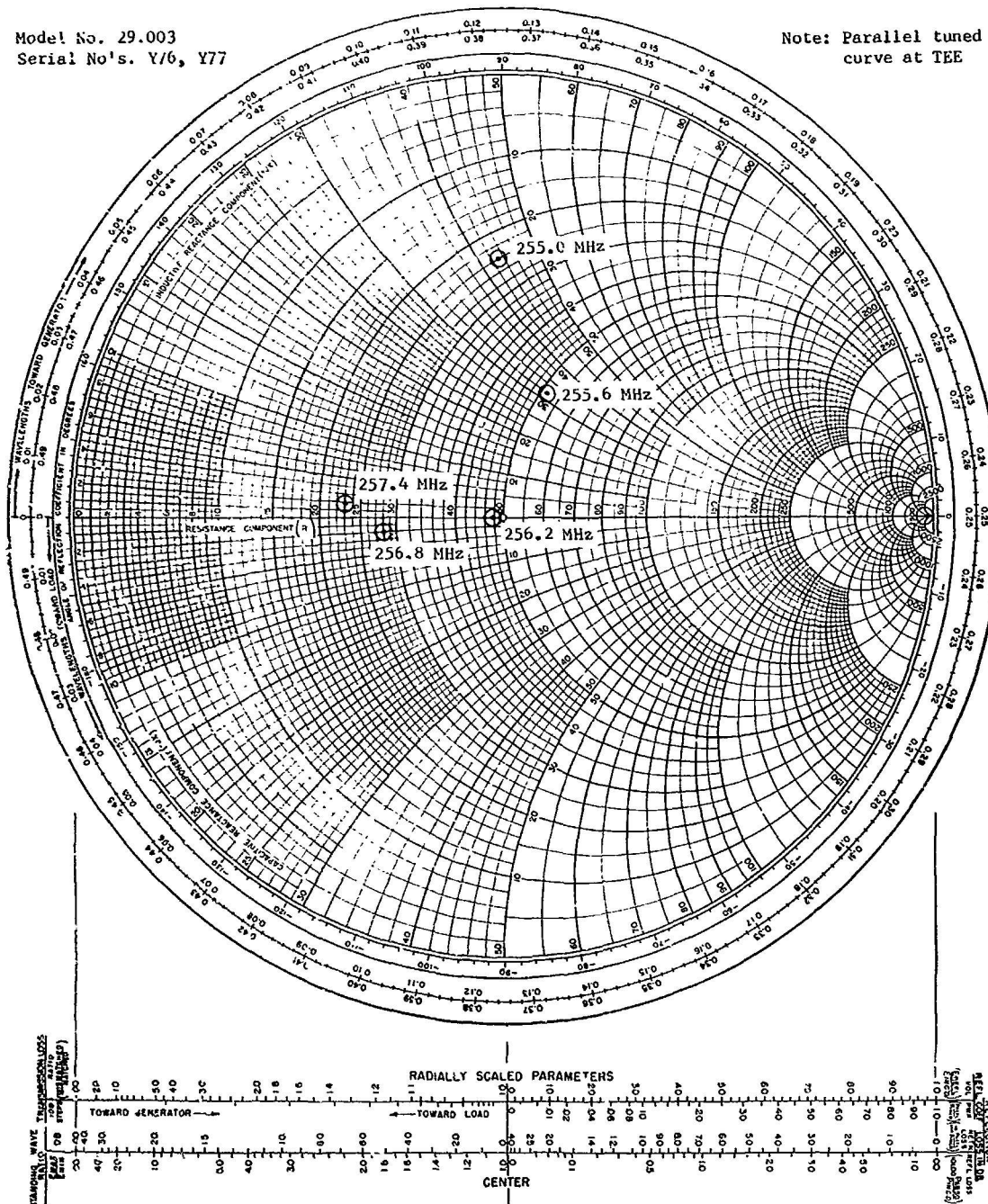


Figure 40. Telemetry No. 2, Antennas Impedance Plot (256.2 MHz)



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SECTION VI  
SYSTEM CALIBRATION DATA



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TABLE 21  
CALIBRATION DATA FOR TELEMETRY SYSTEM NO. 1 (231.4 MHz)

VCO Freq. (kHz)	VCO Serial No.	Lower Band Level		Center Frequency			Upper Band Level	
		Frequency (Hz)	Noise Peak to Peak (Volts dc)	Frequency (Hz)	Discrim. Input (Volts dc)	Noise Peak to Peak (Volts dc)	Frequency (Hz)	Noise Peak to Peak (Volts dc)
70.00	16727	64.779	0.014	70.019	0.740	0.014	75.256	0.016
52.50	16658	48.559	0.022	52.521	0.480	0.022	56.484	0.022
40.00	5834	36.977	0.024	40.000	0.310	0.022	43.009	0.022
30.00	16382	27.775	0.024	30.027	0.210	0.024	32.270	0.026
22.00	15158	20.348	0.032	22.001	0.170	0.030	23.649	0.032
14.50	7819	13.415	0.032	14.494	0.120	0.018	15.574	0.018
10.50	18690	9.701	0.028	10.491	0.115	0.024	11.280	0.024
7.35	20223	6.806	0.045	7.354	0.100	0.046	7.901	0.042
5.40	15890	4.998	0.022	5.394	0.095	0.018	5.799	0.020
3.90	6608	3.609	0.038	3.903	0.082	0.022	4.194	0.018
3.00	15654	2.778	0.042	3.002	0.070	0.042	3.224	0.030
2.30	15539	2.129	0.036	2.302	0.068	0.024	2.476	0.030
1.70	7076	1.571	0.014	1.698	0.055	0.014	1.827	0.014
1.30	10880	1.203	0.018	1.301	—	0.008	1.398	0.010
0.96	10856	0.888	0.012	0.966	—	0.010	1.032	0.018

NOTE: 0.080 Volts Peak to Peak Noise=1% Intermodulation Distortion.

TABLE 21 (Continued)  
CALIBRATION DATA FOR TELEMETRY SYSTEM NO. 1 (231.4 MHz)

System Parameter	Measurements at Power Supply Voltages of:		
	+26 Volts dc	+30 Volts dc	+32 Volts dc
Receiver Video Output (p to p)	5.2	5.0	5.0
Transmitter Frequency (MHz)	231.388	231.388	231.388
Transmitter Output Power (Watts)	6.3	8.0	8.5

TABLE 22  
CALIBRATION DATA FOR TELEMETRY SYSTEM NO. 2 (256.2 MHz)

VCO Freq. (kHz)	VCO Serial No.	Lower Band Level		Center Frequency			Upper Band Level	
		Frequency (Hz)	Noise Peak to Peak (Volts dc)	Frequency (Hz)	Discrim. Input (Volts dc)	Noise Peak to Peak (Volts dc)	Frequency (Hz)	Noise Peak to Peak (Volts dc)
70.00	16709	64.606	0.014	69.870	0.690	0.014	75.130	0.018
52.50	16628	48.531	0.018	52.500	0.440	0.024	56.464	0.024
40.00	20362	37.012	0.028	39.989	0.320	0.026	42.958	0.028
30.00	16391	27.748	0.034	29.997	0.220	0.032	32.241	0.034
22.00	15177	20.379	0.032	22.025	0.170	0.034	23.667	0.034
14.50	16206	13.403	0.036	14.504	0.140	0.022	15.606	0.032
10.50	18778	9.717	0.026	10.504	0.120	0.030	11.290	0.030
7.35	20230	6.804	0.038	7.353	0.100	0.038	7.902	0.028
5.40	20206	5.001	0.020	5.406	0.097	0.018	5.811	0.018

TABLE 22 (Continued)  
CALIBRATION DATA FOR TELEMETRY SYSTEM NO. 2 (256.2 MHz)

VCO Freq. (kHz)	VCO Serial No.	Lower Band Level		Center Frequency			Upper Band Level	
		Frequency (Hz)	Noise Peak to Peak (Volts dc)	Frequency (Hz)	Discrim. Input (Volts dc)	Noise Peak to Peak (Volts dc)	Frequency (Hz)	Noise Peak to Peak (Volts dc)
3.90	15769	3.605	0.054	3.899	0.080	0.018	4.194	0.018
3.00	5050	2.774	0.034	2.999	0.070	0.022	3.224	0.036
2.30	15515	2.124	0.016	2.299	0.067	0.016	2.474	0.032
1.70	7084	1.566	0.016	1.695	0.059	0.018	1.825	0.028

NOTE: 0.080 Volts Peak to Peak = 1% Total Intermodulation Distortion.

System Parameter	Measurements at Power Supply Voltages of:		
	+26 Volts dc	+30 Volts dc	+32 Volts dc
Receiver Video Output (p to p)	5.2	5.0	5.1
Transmitter Frequency (MHz)	256.196	256.196	256.196
Transmitter Output Power (Watts)	4.1	4.3	4.4

TABLE 23  
COMMUTATOR SEGMENTS, SIGNAL OUTPUT VOLTAGES

Segment No.	Allocation	Ouput Voltage (preflight)	Output Voltage (flight)
1	Ground Cal.	Ground	Ground
2	TPS (make)	0.0000	4.7110
3	TPS (break)	0.0000	4.4350
4	Ea	0.0000	3.6380
5	E5	0.0000	3.4610
6	E6	0.0000	2.2560
7	Eb	0.0000	3.7300
8	Despin Weight #1 Mon.	0.8950	3.8600
9	Despin Weight #2 Mon.	0.9440	3.7990
10	Pos. Pulse I Mon.	0.3670	0.3670
11	Pos. Pulse I Mon.	0.3600	0.3600
12	g Timer #4 Mon.	0.8420	3.6250
13	g Timer #3 Mon.	0.8540	3.8340
14	g Timer #2 Mon.	0.8680	3.7600
15	g Timer #1 Mon.	0.9170	3.7590
16	+28V Instr. Mon.	3.8580	3.8580
17	TPS (make)	0.0000	4.7110
18	TPS (break)	0.0000	4.4350
19	E <sub>A</sub> = SR Fire	0.0000	3.6380

TABLE 23 (Continued)  
COMMUTATOR SEGMENTS, SIGNAL OUTPUT VOLTAGES

Segment No.	Allocation	Output Voltage (preflight)	Output Voltage (flight)
20	Explosive Bolt Fire	0.0000	3.4610
21	Explosive Bolt B/U	0.0000	2.2560
22	Stage II Ignition	0.0000	3.7300
23	2.5 V Cal.	2.4940	2.4940
24	Pitch Mag. Bias	2.3960	2.3960
25	Yaw Mag. Bias	2.4000	2.4000
26	Roll Mag. Bias	2.3970	2.3970
27	PcI BLH Mon.	0.5041	0.5041
28	PcII BLH Mon.	0.5010	0.5010

TABLE 24  
VEHICLE ORDNANCE MONITOR-RESISTORS

Resistor No.	Nominal Value (ohms)	Measured Value (ohms)
F1	2200	(potted)*
R2	1000	(potted)*
R3	2200	(potted)*
R4	1000	990
R5	3300	3300
R6	1000	1000
R7	22000	22500

TABLE 24 (Continued)  
VEHICLE ORDNANCE MONITOR-RESISTORS

Resistor No.	Nominal Value (ohms)	Measured Value (ohms)
R8	4700	4770
R9	1000	1000
R10	22000	22600
R11	4300	4450
R12	1000	990
R13	3300	3270
R14	1000	1010
R15	3600	3760
R16	1000	1000
R17	1000	1030
R18	3300	3400
R19	3300	3230
R20	1000	990

\*See Table 32 for Voltage ratio measurements.

TABLE 25  
PAYLOAD RESISTOR-BOARD MEASUREMENTS

Terminal Board	Terminal Numbers	Resistance (ohms)
TB101	1 - 2	97,000
TB103	1 - 2	1,017
	3 - 4	496
	7 - 8	498
TB104	7 - 8	990
TB105	1 - 2	112,200
	3 - 4	110,000
	7 - 8	969
TB106	1 - 2	111,100
	3 - 4	112,200
	5 - 6	110,800
	7 - 8	110,900
TB107	7 - 8	50
TB108	5 - 6	26,900
	7 - 8	3,960
TB111	1 - 2	110,700

TABLE 26  
CALIBRATOR OUTPUT-VOLTAGE TEST (Serial No. 0060)

Channel No.	Voltage Step	Input (24 Volts dc)	Input (28 Volts dc)	Input (30 Volts dc)	Input (31 Volts dc)
1	Open	—	—	—	—
	Ground	0.000	0.000	0.000	0.000
	1	1.000	1.000	1.000	1.000
	2	2.000	2.001	2.000	2.000
	3	3.001	3.001	3.001	3.000
	4	4.001	4.001	4.000	4.000
	5	5.001	5.001	5.001	5.000
	Open	—	—	—	—
2	Open	—	—	—	—
	Ground	0.000	0.000	0.000	0.000
	1	1.000	1.000	1.000	1.000
	2	2.000	2.000	2.000	2.000
	3	3.000	3.001	3.001	3.000
	4	4.001	4.000	4.000	4.000
	5	5.001	5.000	5.000	5.000
	Open	—	—	—	—
3	Open	—	—	—	—
	Ground	0.000	0.000	0.000	0.000
	1	1.000	1.000	1.000	1.000
	2	2.000	2.000	2.000	2.000
	3	3.000	3.001	3.001	3.000
	4	4.001	4.000	4.000	4.000
	5	5.001	5.001	5.001	5.000
	Open	—	—	—	—
4	Open	—	—	—	—
	Ground	0.000	0.000	0.000	0.000

TABLE 26 (Continued)  
CALIBRATOR OUTPUT-VOLTAGE TEST (Serial No. 0060)

Channel No.	Voltage Step	Input (24 Volts dc)	Input (28 Volts dc)	Input (30 Volts dc)	Input (31 Volts dc)
	1	1.000	1.000	1.000	1.000
	2	2.000	2.000	2.000	2.000
	3	3.000	3.001	3.001	3.000
	4	4.001	4.000	4.000	4.000
	5	5.001	5.001	5.001	5.000
	Open	—	—	—	—
Supply Voltage (5 Volts dc)		5.002	5.001	5.001	5.002

TABLE 27  
CALIBRATOR OUTPUT-VOLTAGE TEST (Serial No. 0052)

Channel No.	Voltage Step	Input (24 Volts dc)	Input (28 Volts dc)	Input (30 Volts dc)	Input (31 Volts dc)
1	Open	—	—	—	—
	Ground	0.000	0.000	0.000	0.000
	1	1.000	1.000	1.000	1.000
	2	2.000	2.000	2.000	2.000
	3	3.000	3.000	3.000	2.999
	4	3.999	4.000	4.000	3.999
	5	4.999	4.999	5.000	4.999
	Open	—	—	—	—
2	Open	—	—	—	—
	Ground	0.000	0.000	0.000	0.000
	1	1.000	1.000	1.000	1.000
	2	2.000	2.000	2.000	2.000
	3	2.999	3.000	3.000	2.999
	4	3.999	4.000	4.000	3.999
	5	4.999	4.999	5.000	4.999
	Open	—	—	—	—

TABLE 27 (Continued)  
CALIBRATOR OUTPUT-VOLTAGE TEST (Serial No. 0052)

Channel No.	Voltage Step	Input (24 Volts dc)	Input (28 Volts dc)	Input (30 Volts dc)	Input (31 Volts dc)
3	Open	—	—	—	—
	Ground	0.000	0.000	0.000	0.000
	1	1.000	1.000	1.000	1.000
	2	2.000	2.000	2.000	2.000
	3	2.999	3.000	3.000	2.999
	4	3.999	4.000	4.000	3.999
	5	4.999	4.999	5.000	4.999
	Open	—	—	—	—
4	Open	—	—	—	—
	Ground	0.000	0.000	0.000	0.000
	1	1.000	1.000	1.000	1.000
	2	2.000	2.000	2.000	2.000
	3	2.999	3.000	3.000	2.999
	4	3.999	4.000	4.000	3.999
	5	4.999	4.999	5.000	4.999
	Open	—	—	—	—
Supply Voltage (5 Volts dc)		5.000	5.001	5.002	5.000

TABLE 28  
DESPIN MONITOR, RESISTOR-BOARD MEASUREMENTS

Terminal Board	Terminal Numbers	Resistance (ohms)
TB201	1 - 2	27,700
	3 - 4	5,220
	5 - 6	20,100
	7 - 8	1,060
TB202	1 - 2	27,200
	3 - 4	5,350
	5 - 6	20,700
	7 - 8	982
TB203	1 - 2	27,100
	3 - 4	5,210
	5 - 6	20,500
	7 - 8	954
TB204	1 - 2	28,100
	3 - 4	5,040
	5 - 6	20,200
	7 - 8	983
TB205	1 - 2	27,100
	3 - 4	5,030
	5 - 6	20,300
	7 - 8	1,009
TB206	1 - 2	28,500
	3 - 4	5,180
	5 - 6	20,000
	7 - 8	1,119

## VIBRATION TESTS ON RAYMOND g TIMER

Vibration tests were performed on the Raymond g timer, as a result of the Astrobee 1500 (16.06 GR) Design Review Meeting. There was no record of any previous Astrobee 1500 prototype vibration tests on this timer, and a decision was made to test one timer unit. Vibration levels for the tests were obtained from NASA Document S-320-SR2, dated 20 June 1968, and entitled "General Environmental Test Specifications for Flight Acceptance of Sounding Rocket Payloads."

The tests were performed on Raymond g timer, model number 1060-5C-180T-3SPDT, serial number 12195. Prior to vibration testing, the cams were adjusted for approximately 10.0 seconds on cam number 1, and approximately 169.0 seconds on cam number 3. Cam number 2 was not used during this series of tests. A series of three test runs were made, to check the repeatability of the timer operation, and measurements were made between the contact closures on cams number 1 and number 3. The test results were:

Test Run No. 1 = 159.6 seconds

Test Run No. 2 = 159.4 seconds

Test Run No. 3 = 159.4 seconds

The following types of vibration tests were conducted:

### Vibration Test No. 1 (Thrust Axis)

Sweep Rate of 2 Octaves per Minute

Sine Sweep with prototype levels as follows:

10 Hz to 15 Hz Frequency at 0.5 inches Double Amplitude

15 Hz to 45 Hz Frequency at 6 g

45 Hz to 55 Hz Frequency at 18 g

55 Hz to 2 kHz Frequency at 7.5 g

### Vibration Test No. 2 (Thrust Axis)

Period of 20 seconds

Random Vibration with prototype levels as follows:

20 Hz to 2 kHz Frequency at  $0.16 \text{ g}^2/\text{Hz}$

17.6 g rms

Vibration Test No. 3 (Lateral Axis)

Period of 20 seconds

Random Vibration with prototype levels as follows:

20 Hz to 2 kHz Frequency at  $0.16 \text{ g}^2/\text{Hz}$   
11.5 g rms

Vibration Test No. 4 (Lateral Axis)

Sweep Rate of 2 Octaves per Minute

Sine Sweep with prototype levels as follows:

5 Hz to 31 Hz Frequency at 9 inches per second (constant velocity)  
31 Hz to 0.3 kHz Frequency at 4.5 g  
0.3 kHz to 2 kHz Frequency at 7.5 g

Vibration Test No. 5 (Lateral Axis)

Sweep Rate of 2 Octaves per Minute

Sine Sweep with prototype levels as follows:

5 Hz to 31 Hz Frequency at 9 inches per second (constant velocity)  
31 Hz to 0.3 kHz Frequency at 4.5 g  
0.3 kHz to 2 kHz Frequency at 7.5 g

Vibration Test No. 6 (Lateral Axis)

Period of 20 seconds

Random Vibration with prototype levels as follows:

20 Hz to 2 kHz Frequency at  $0.16 \text{ g}^2/\text{Hz}$   
11.6 g rms

The Random Vibration Test Specification requires only a short test-period duration of 20 seconds. Therefore, the timer was started and allowed to run for approximately 15 seconds, prior to the random vibration testing. The timer was restarted at the beginning of the sine sweep, and completed its cycle prior to the end of the sweep. The maximum timer range is 180 seconds, and the test specification requires approximately 4 minutes for a complete sweep.

Timer operation was satisfactory during all tests. During Vibration Test No. 1 the g weight retaining spring broke in approximately 20 seconds. However, the broken spring would not affect the operation of the timer in any way. The operating times of the timer, during the vibration tests, were as follows:

Vibration Test No. 1 = 158.6 seconds  
Vibration Test No. 2 = 158.6 seconds

Vibration Test No. 3 = 159.0 seconds

Vibration Test No. 4 = 158.2 seconds

Vibration Test No. 5 = 158.8 seconds

Vibration Test No. 6 = 158.5 seconds

A series of three post-vibration test runs were made, with the timer operation results as follows:

Timing Test No. 1 = 159.4 seconds

Timing Test No. 2 = 159.3 seconds

Timing Test No. 3 = 159.1 seconds

TABLE 29  
g TIMERS, TIMING TESTS

g Timer Serial No.	Test Run No.	Switch 1 Closed (Sec.)	Switch 1 Opened (Sec.)	Switch 2 Closed (Sec.)	Switch 3 Closed (Sec.)
10986 (spare)	1	88.2	98.2	90.2	90.0
	2	88.0	93.0	90.2	90.2
	3	88.0	98.0	90.0	90.0
12187 (2)	1	88.0	98.0	90.1	90.1
	2	88.0	98.0	90.2	90.2
	3	88.0	98.0	90.2	90.2
12189 (3)	1	88.0	98.0	90.2	90.3
	2	88.0	98.0	90.3	90.4
	3	87.8	97.8	90.1	90.3
12196 (4)	1	88.1	98.1	90.2	90.4
	2	87.8	97.8	90.2	90.0
	3	88.0	98.0	90.2	90.0
12205 (1)	1	87.6	97.6	90.0	90.2
	2	87.8	97.8	90.0	90.2
	3	87.6	97.6	90.0	90.2

NOTE: Switch 1 = Despin (pins A, B, C)  
Switch 2 = Antenna Motor (pins D, E, F)  
Switch 3 = Monitor (pins G, H, J)

TABLE 30  
M1 TIMER, TIMING TESTS

Test Run No.	Pins A, B, C (Sec.)	Pins D, E, F (Sec.)	Pins H, J, K (Sec.)
1	7.8	54.2	57.5
2	7.8	54.5	57.6
3	7.8	54.4	57.6
4	8.0	54.3	57.4
5	8.0	54.4	57.6

TABLE 31  
M5 TIMER, TIMING TESTS

Test Run No.	Time (Sec.)
1	1.25
2	1.25
3	1.26
4	1.27
5	1.26

## TEST OF ASTROBEE 1500 DESPIN CIRCUIT FOR FLIGHT 16.06 GR

The Astrobee 1500 despin squib circuit was modified for Flight 16.06 GR. The Modifications included the addition of a squib current monitor circuit, and an additional Raymond (model 1060) g timer, in each of the redundant timing circuits.

Squib circuit Number 1 consisted of:

- g Timer Number 1
- g Timer Number 2
- Battery B1
- Squib Fire Monitor Circuit

After g Timers Number 1 and Number 2 were allowed to time-out, the squib battery was disconnected, and an Alnico Ignitor Tester (GSFC No. 207858), was connected to the battery leads. A short circuit was placed across the battery leads, as close as possible to the Squib itself. The measured resistance of Squib Circuit Number 1 was 0.26 ohms. The same test was repeated for Squib Circuit Number 2, and the measured resistance was 0.19 ohms.

The Halex (model 2801) guillotines have a recommended firing current of 5.0 amperes per bridge-wire, with resistance of  $0.66 \pm 0.08$  ohms. Calculations indicated that the Gulton 6VO.250P battery would be marginal in providing the recommended firing current to the squib, since the measured internal resistance of these batteries ranges from 0.13 ohms to 0.16 ohms per cell.

As a result of the above tests and calculations, a decision was made to change the ordnance batteries to Gulton 10VO.250SSCP. This battery has an improved seal to prevent leakage, and a fully welded internal construction. The welded construction provides a lower internal resistance, and allows higher peak currents than the previously used batteries.

A series of pulse-tests also was performed on the 10VO.250SSCP batteries. The tests indicated that they would provide peak currents in excess of 10 amperes, with a battery terminal voltage in excess of 6 volts. Calculations indicated that these batteries are capable of providing 100 percent of the recommended firing current to the squib.

For a schematic diagram of the despin circuit used for Flight 16.06 GR, see Figure 41.

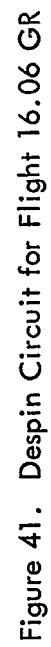


TABLE 32  
MISCELLANEOUS SYSTEM TEST DATA  
DESPIN WEIGHT RELEASE AND g TIMERS MONITOR VOLTAGES

Component	Monitor Pin No. (J200)	Output Voltage (Preflight) (Volts dc)	Output Voltage (Flight) (Volts dc)
12187	13	0.925	3.886
12189	16	0.850	3.746
12196	15	0.861	3.963
12205	14	0.884	4.029
Weight No. 1 (S1)	19	0.896*	3.855**
Weight No. 2 (S2)	20	0.945*	3.795**
Squib No. 1	17	—	0.649 (Monitor Bias Level)
Squib No. 2	18	—	0.631 (Monitor Bias Level)

\*Weight ON  
\*\*Weight OFF

#### DESPIN SQUIB RESISTANCE

Timer 1 and Timer 2 - Squib No. 1	
Line Resistance	= 0.33 ohms <u>-0.07 ohms</u> , Tester Lead Res. 0.26 ohms
Timer 3 and Timer 4 - Squib No. 2	
Line Resistance	= 0.27 ohms <u>-0.07 ohms</u> , Tester Lead Res. 0.20 ohms

#### ANTENNA EXTENDING MOTOR CIRCUIT

P170 Pin A to P170 Pin C - Resistance = 0.26 ohms <u>-0.07 ohms</u> , Tester Lead Res. 0.19 ohms
P170 Pin B to P170 Pin D - Resistance = 0.24 ohms <u>-0.07 ohms</u> , Tester Lead Res. 0.17 ohms
NOTE: Measurements were made with Timers run down.

TABLE 32 (Continued)  
MISCELLANEOUS SYSTEM TEST DATA

VEHICLE ORDNANCE, CALIBRATION CHECK VOLTAGES

Function/Event	Signal Input To:	Input Voltage (Volts dc)	Signal Output From:	Output Voltage (Volts dc)
E1 (TPS Make)	R7	27.000	R9	4.716
E2 (TPS Break)	R10	27.000	R12	4.435
EA = E3 +E4:	R17, R18	4.500	R20	3.638
E3 (Spin Rockets, mechanical)	R17	4.500	R20	3.439
E4 (Spin Rockets, electrical)	R18	4.500	R20	2.229
E5 (Explosive Bolts, electrical)	R4	4.500	R6	3.461
E6 (Explosive Bolts, backup unit)	R1	4.500	R2	2.256
EB = E7 +E8:	R13, R14	4.500	R16	3.730
E7 (Stage II Ignition, electrical)	R13	4.500	R16	2.406
E8 (Stage II Ignition, mechanical)	R14	4.500	R16	3.540

ALTITUDE SWITCHES, CALIBRATION (DESPIN)

Switch No.	Test Run No.	Altitude To Open	Altitude To Close
1	1	20,400	22,200
	2	20,400	22,200
2	1	20,300	22,000
	2	20,600	22,000
3	1	19,400	20,800
	2	19,400	20,700
4	1	20,400	21,600
	2	20,400	21,600

TABLE 32 (Continued)  
MISCELLANEOUS SYSTEM TEST DATA

RECEIVERS

$E_{in} = 4.5$ Volts dc
Receiver No. 1 Only - $E_o = 3.010$ (Vdc)
Receiver No. 2 Only - $E_o = 1.441$ (Vdc)
Receivers No. 1 and No. 2 - $E_o = 3.515$ (Vdc)

INSTRUMENTATION MONITOR

$E_{in} = 30.005$ (Vdc)
$E_{out} = 3.857$ (Vdc)

CALIBRATION TIMING

Performance Telemetry = 57.5 Seconds (Resistance = 510,000 ohms)
Experiment Telemetry = 180.0 Seconds (Resistance = 2.2 Megohms)

5 VOLTS DC REGULATOR

$E_{in} = 30.005$ (Vdc)
$E_{out} = 5.001$ (Vdc)

2.5 VOLTS DC COMMUTATOR CALIBRATION

$E_{out} = 2.495$ (Vdc)
-------------------------

THRUST PRESSURE SWITCH TEST

TPS Opened: 230 psia (1.9 Vdc)
TPS Closed: 222 psia (1.75 Vdc)